Escola de Camins
Escola Tècnica Superior d'Enginyeria de Camins, Canals i Ports
UPC BARCELONATECH

Anàlisi del cicle de vida de llacunes d'alta càrrega per a la depuració d'aigües residuals i la recuperació d'energia i nutrients

ANNEXES

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Màster en:
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Departament d'Enginyeria Civil i Ambiental

TREBALL FINAL DE MÀSTER

ANNEX 1.

TREBALLS DEL DISSENY DELS SISTEMES DE TRACTAMENT D'AIGÜES RESIDUALS

A. SISTEMES DE HRAP

TAULA DE CONTINGUTS

1. ESCENARI 1

1.1. DADES DE PARTIDA

INPUT
OUTPUT

Paràmetre	Valors	Unitats	Rang de valors acceptables
Població servida	10.000	hab	
Dotació	195	L/hab·dia	*120 - 300*
Cabal de l'afluent	1.950.000	L/dia	
	1.950	m³/dia	
	81,25	m³/h	

1.2. DECANTADOR PRIMARI

Paràmetre	Valors	Unitats	Comentaris/Rang de valors acceptables
Forma	-	-	*Rectangular*
Cabal d'entrada	81,25	m³/h	*Cabal de l'afluent*
Temps de retenció hidràulica	2,50	h	*1,50 - 2,50*
Volum	203,13	m³	
Profunditat	3,50	m	*3 - 4,50*
Superfície	58,04	m²	
Relació llargada/amplada	3,00	-	*3 - 8*
Amplada	4,40	m	
Llargada	13,19	m	
Espessor de formigó	0,20	m	
Volum de formigó	36,24	m³	
Massa d'acer	2.899,02	kg	

Verificacions	Valors	Unitats	Rang valors acceptables
Càrrega hidràulica superficial	33,60	m³/dia·m²	*20 - 40*
	1,40	m3/h·m²	*1,35 - 2,03*

CONSUM ENERGÈTIC DECANTADOR PRIMARI	Paràmetre	Valors	Unitats
	Cabal de fangs primaris	17,22	m³/dia
	Consum específic d'energia per bombar	1.800	kJ/m³
	Energia (electricitat) requerida per la bomba de fangs primaris	30,99	MJ/dia
		8,61	kWh/dia

1.3. HRAP

Paràmetre	Valors			Unitats	Comentaris/Rang de valors acceptables
	HRAP 4 dies	HRAP 6 dies	HRAP 8 dies		
Taxa d'emissió	60	60	60	g DBO/hab·dia	
Càrrega contaminant	600	600	600	kg DBO/dia	
Velocitat de càrrega orgànica	280,00	186,67	140,00	kg DBO/ha·dia	
Eficiència del pretractament	70	70	70	%	
Càrrega contaminant de l'afluent	420	420	420	kg DBO/dia	
Superfície total	1,50	2,25	3,00	ha	
	15.000	22.500	30.000	m²	
Forma	-	-	-	-	*Ovalada*
Cabal d'entrada	81,25	81,25	81,25	m³/h	*Cabal de l'afluent*
Temps de retenció hidràulica	4	6	8	dia	
Volum de tractament	7.800	11.700	15.600	m³	
Nre. de HRAP	2	3	4	-	
Volum de tractament 1 HRAP	3.900	3.900	3.900	m³	
Profunditat d'aigua	0,40	0,40	0,40	m	
Superfície 1 HRAP	9.750	9.750	9.750	m²	
Amplada 1 HRAP	12	12	12	m	*7 - 12*
Llargada 1 HRAP	812,50	812,50	812,50	m	
Perímetre 1 HRAP	1.649	1.649	1.649	m	*Considerant HRAP en forma rectangular*
Profunditat dels murs	0,50	0,50	0,50	m	*10 cm més que la profunditat de tractament*
Espessor de formigó	0,20	0,20	0,20	m	
Volum de formigó als murs perimetrals	329,80	494,70	659,60	m³	
Volum de formigó a la base	3.900	5.850	7.800	m³	
Volum total de formigó	4.229,80	6.344,70	8.459,60	m³	*CAL AGAFAR EL CAS MÉS DESFAVORABLE*
Massa d'acer	338.384	507.576	676.768	kg	
Superfície total de les HRAP	19.500	29.250	39.000	m²	
Massa d'acer a la pala d'agitació 1 HRAP	381,36	381,36	381,36	kg	
Massa de fibra de vidre a la pala d'agitació 1 HRAP	976,52	976,52	976,52	kg	
Nre. de pales d'agitació	2	3	4	-	
Massa d'acer total a les pales d'agitació	762,71	1.144,07	1.525,42	kg	*CAL AGAFAR EL CAS MÉS DESFAVORABLE*
Massa de fibra de vidre total a les pales d'agitació	1.953,04	2.929,56	3.906,08	kg	
Diferent TRH segons condicions climàtiques: *Hivern (novembre-abril) = 8 dies = 4 HRAP; Estiu (maig-juliol) = 4 dies = 2 HRAP; Resta de l'any (agost-octubre) = 6 dies = 3 HRAP*					

	Paràmetre	Valors			Unitats	Comentaris
PÈRDUA DE CÀRREGA CANAL I CANVIS DE SENTIT		HRAP 4 dies	HRAP 6 dies	HRAP 8 dies		
	Superfície 1 HRAP	9.750	9.750	9.750	m^2	
	Amplada	12	12	12	m	
	Llargada	812,50	812,50	812,50	m	
	Coeficient de rugositat de Manning	0,025	0,025	0,025	-	
	Profunditat d’aigua	0,40	0,40	0,40	m	$\Delta d_1 = \dfrac{v^2 \cdot l}{\left(\frac{1{,}486}{n}\right)^2 \cdot \left(\frac{h \cdot a}{a+2h}\right)^{1{,}26}}$
	Velocitat de l’aigua	0,15	0,15	0,15	m/s	
	Pèrdua de càrrega en el canal 1 HRAP	0,018	0,018	0,018	m	
	Nre. de canvis de sentit	2	2	2	-	
	Pèrdua de càrrega en el canvi de sentit 1 HRAP	0,0023	0,0023	0,0023	m	$\Delta d_2 = \frac{v^2}{2g}$ $\quad \Delta d = \Delta d_1 + \Delta d_2$
	Pèrdua de càrrega total 1 HRAP	0,0201	0,0201	0,0201	m	

	Paràmetre	Valors			Unitats	Comentaris/Rang de valors acceptables
CONSUM ENERGÈTIC HRAP (1)		HRAP 4 dies	HRAP 6 dies	HRAP 8 dies		
	Cabal d'aigua en moviment	0,72	0,72	0,72	m^3/s	
	Pes específic de l'aigua a 20ºC	9,78	9,78	9,78	kN/m^3	
	Pèrdua de càrrega total 1 HRAP	0,0201	0,0201	0,0201	M	
	Eficiència de la pala d'agitació	50	50	50	%	*20 - 60*
	Nre. de HRAP	2	3	4	-	
	Potència requerida	0,5662	0,8493	1,1324	kW	
		0,0726	0,0726	0,0726	W/m^3	
	Consum energètic	9,0592	9,0592	9,0592	kWh/dia·ha	*Associat al moviment de la pala d’agitació*
		0,9059	0,9059	0,9059	$Wh/dia{\cdot}m^2$	
		1,7422	1,7422	1,7422	$Wh/dia{\cdot}m^3$	

CONSUM ENERGÈTIC HRAP (2)

Paràmetre	Valors															Unitats
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Energia (electricitat) requerida a les HRAP	27,18	27,18	27,18	27,18	13,59	13,59	13,59	20,38	20,38	20,38	27,18	27,18	22,08	27,18	13,59	kWh/dia

1.4. DECANTADOR SECUNDARI

Paràmetre	Valors	Unitats	Comentaris
Forma	-	-	*Cilíndrica + cònica*
Cabal d'entrada	81,25	m^3/h	*Cabal de l'afluent*
Temps de retenció hidràulica	3	h	
Volum	243,75	m^3	
Secció cònica	6	%	
Espessor de formigó	0,20	m	
Profunditat total	2,50	m	
Profunditat de la secció cònica	0,20	m	
Profunditat de la secció cilíndrica	2,30	m	
Diàmetre	11,45	m	
Generatriu exterior del con	5,93	m	
Superfície exterior del con	110,38	m^2	
Superfície exterior del cilindre	85,63	m^2	
Superfície exterior total	196,01	m^2	
Volum de formigó	39,20	m^3	
Massa d'acer	3.136,17	kg	

Verificacions	Valors	Unitats	Comentaris
Superfície en planta	105,98	m^2	*Considerant només la secció cilíndrica*
Càrrega hidràulica superficial	18,40	$m^3/dia \cdot m^2$	*Condicions seques: 16-29 $m^3/dia \cdot m^2$;*
	0,77	$m^3/h \cdot m^2$	*Condicions òptimes: 41-65 $m^3/dia \cdot m^2$*

	Paràmetre	Valors	Unitats
CONSUM ENERGÈTIC DECANTADOR SECUNDARI	Cabal de biomassa microalgal	9,35	m^3/d
	Consum específic d'energia per bombar	1.800	kJ/m^3
	Energia (electricitat) requerida per bombar la biomassa microalgal	16,82	MJ/dia
		4,67	kWh/dia
	Cabal de recirculació de biomassa microalgal	0,46	m^3/dia
	Consum específic d'energia per recircular	1.800	kJ/m^3
	Energia (electricitat) requerida per recircul·lar la biomassa microalgal	0,83	MJ/dia
		0,23	kWh/dia

1.5. ESPESSIDOR

Paràmetre	Valors	Unitats	Comentaris
Forma	-	-	*Cònica*
Cabal d'entrada	14,33	m^3/dia	*Cabal de biomassa microalgal*
	0,60	m^3/h	
Temps de retenció hidràulica	24	h	
Volum	14,33	m^3	
Radi	2,00	m	
Profunditat	3,50	m	
Superfície	25,33	m^2	
Espessor dels murs	0,10	m	
Volum de formigó	2,53	m^3	
Massa d'acer	202,63	kg	

1.6. PRETRACTAMENT TÈRMIC

Paràmetre	Valors	Unitats	Comentaris
Forma	-	-	*Cilíndrica + esfèrica*
Cabal d'entrada	14,33	m^3/dia	*Cabal de biomassa microalgal*
	0,60	m^3/h	
Temps de retenció hidràulica	10	h	
Volum útil	5,97	m^3	
Volum total	7,96	m^3	
Radi	1,36	m	
Perímetre	8,57	m	
Profunditat útil	1,02	m	
Superfície dels murs	8,76	m^2	
Superfície de la base	5,84	m^2	
Superfície de la cúpula	11,68	m^2	
Superfície total	26,28	m^2	
Espessor de formigó	0,15	m	
Volum de formigó	3,94	m^3	
Massa d'acer	315,39	kg	

1.7. DIGESTOR ANAERÒBIC

Paràmetre	Valors	Unitats	Rang de valors acceptables
Forma	-	-	*Cilíndrica + esfèrica*
Cabal d'entrada	40,74	m^3/dia	*Cabal de biomassa microalgal + fang primari*
Temps de retenció hidràulica	20	d	*10 - 20*
Volum útil	814,80	m^3	
Volum total	1.086,40	m^3	
Radi	7,02	m	
Perímetre	44,10	m	
Altura útil	5,26	m	
Superfície dels murs	232,17	m^2	
Superfície de la base	154,78	m^2	
Superfície de la cúpula	309,56	m^2	
Superfície total	696,50	m^2	
Espessor de formigó	0,20	m	
Volum de formigó	139,30	m^3	
Massa d'acer	11.144,05	kg	

PRODUCCIÓ D'ENERGIA EN LA CODIGESTIÓ ANAERÒBIA																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Producció mitjana de biomassa microalgal	3,30	3,30	12,50	12,50	25,80	25,80	25,80	10,50	10,50	10,50	3,30	3,30	12,26	25,80	3,30	g SST/m^2·dia
Contingut de SV a la biomassa microalgal	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	%
Producció mitjana de biomassa microalgal	2,31	2,31	8,75	8,75	18,06	18,06	18,06	7,35	7,35	7,35	2,31	2,31	8,58	18,06	2,31	g SV/m^2·dia
Eficiència de separació del sistema	91,90	91,90	93,00	93,00	92,60	92,60	92,60	94,20	94,20	94,20	91,90	91,90	92,83	94,20	91,90	%
Producció recol·lecció de biomassa microalgal	2,12	2,12	8,14	8,14	16,72	16,72	16,72	6,92	6,92	6,92	2,12	2,12	7,98	16,72	2,12	g SV/m^2·dia
Producció diària de biomassa microalgal	63,69	63,69	244,13	244,13	250,85	250,85	250,85	155,78	155,78	155,78	63,69	63,69	163,58	250,85	63,69	kg SV/dia
Producció diària de fang primari	191,06	191,06	732,38	732,38	752,56	752,56	752,56	467,35	467,35	467,35	191,06	191,06	490,73	752,56	191,06	kg SV/dia

PRODUCCIÓ D'ENERGIA EN LA CODIGESTIÓ ANAERÒBIA																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Producció diària total	254,75	254,75	976,50	976,50	1.003,41	1.003,41	1003,41	623,13	623,13	623,13	254,75	254,75	654,30	1003,41	254,75	kg SV/dia
Rendiment del CH_4	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	L/kg SV
Producció de CH_4	117,18	117,18	449,19	449,19	461,57	461,57	461,57	286,64	286,64	286,64	117,18	117,18	300,98	461,57	117,18	m^3 CH_4/dia
Potència produïda pel CH_4	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	kWh/m^3 CH_4
Producció d'energia	1.171,84	1.171,84	4.491,90	4.491,90	4.615,70	4.615,70	4.615,70	2.866,41	2.866,41	2.866,41	1.171,84	1.171,84	3.009,79	4.615,70	1.171,84	kWh/dia
Rati d'energia al pretractament	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Energia disponible	1.171,84	1.171,84	4.491,90	4.491,90	4.615,70	4.615,70	4.615,70	2.866,41	2.866,41	2.866,41	1.171,84	1.171,84	3.009,79	4.615,70	1.171,84	kWh/dia
Eficiència per cogeneració (electricitat)	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	%
Eficiència per cogeneració (calor)	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	%
Producció d'electricitat (cogeneració)	410,14	410,14	1.572,17	1.572,17	1.615,50	1.615,50	1.615,50	1.003,24	1.003,24	1.003,24	410,14	410,14	1.053,43	1.615,50	410,14	kWh/dia
Producció de calor (cogeneració)	644,51	644,51	2.470,55	2.470,55	2.538,64	2.538,64	2.538,64	1.576,53	1.576,53	1.576,53	644,51	644,51	1.655,38	2.538,64	644,51	kWh/dia
Producció de calor (amb caldera)	1.054,65	1.054,65	4.042,71	4.042,71	4.154,13	4.154,13	4.154,13	2.579,77	2.579,77	2.579,77	1.054,65	1.054,65	2.708,81	4.154,13	1054,65	kWh/dia

PRODUCCIÓ DE BIOGÀS																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Proporció de CH_4 al biogàs	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	%
Producció de biogàs	167,41	167,41	641,70	641,70	659,39	659,39	659,39	409,49	409,49	409,49	167,41	167,41	429,97	659,39	167,41	m^3/dia

CONSUM ENERGÈTIC DIGESTOR ANAERÒBIC (CALOR)																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Concentració de biomassa microalgal a la mescla	0,03	0,03	0,04	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,03	0,03	0,04	0,05	0,03	% SST
SST a la biomassa microalgal recol·lectada	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	%
Concentració de SV a la biomassa microalgal	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	g SV/L
Cabal de biomassa microalgal	3,64	3,64	13,95	13,95	14,33	14,33	14,33	8,90	8,90	8,90	3,64	3,64	9,35	14,33	3,64	m^3/dia
Cabal de biomassa microalgal	23,48	23,48	28,00	28,00	29,56	29,56	29,56	35,80	35,80	35,80	23,48	23,48	28,83	35,80	23,48	m^3/dia
Cabal de fang primari	70,43	70,43	84,01	84,01	88,69	88,69	88,69	107,41	107,41	107,41	70,43	70,43	86,50	107,41	70,43	m^3/dia
Concentració de SV al fang primari	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	28,50	g SV/L
Cabal de fang primari	6,70	6,70	25,70	25,70	26,41	26,41	26,41	16,40	16,40	16,40	6,70	6,70	17,22	26,41	6,70	m^3/dia
Cabal total	93,91	93,91	112,01	112,01	118,25	118,25	118,25	143,21	143,21	143,21	93,91	93,91	115,34	143,21	93,91	m^3/dia
Cabal total	10,34	10,34	39,65	39,65	40,74	40,74	40,74	25,30	25,30	25,30	10,34	10,34	26,57	40,74	10,34	m^3/dia
TRH digestor anaeròbic	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	dia
Volum útil del digestor anaeròbic	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	814,80	m^3
Volum total del digestor aneròbic	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	1.086,40	m^3
Radi del digestor anaeròbic	7,02	7,019	7,019	7,019	7,019	7,019	7,019	7,019	7,019	7,019	7,019	7,019	7,02	7,02	7,02	m
Perímetre del digestor anaeròbic	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	44,10	m
Altura útil del digestor aneròbic	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	5,26	m
Superfície dels murs del digestor anaeròbic	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	464,34	m^2
Densitat de la biomassa microalgal (= H_2O)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	kg/m^3
Calor específica de la biomassa microalgal (= H_2O)	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	4,18	kJ/kg·ºC

CONSUM ENERGÈTIC DIGESTOR ANAERÒBIC (CALOR)																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Temperatura del digestor anaeròbic	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	ºC
Temperatura de la biomassa microalgal	6,81	8,97	11,80	15,30	17,91	22,16	25,54	24,48	24,23	22,14	13,66	12,51	17,13	25,54	6,81	ºC
Coeficient de transmissió de calor dels murs del digestor anaeròbic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	$W/m^2 \cdot ºC$
Temperatura ambient	11,57	10,14	13,37	15,42	16,81	21,75	26,36	25,69	23,07	20,75	14,18	11,89	17,58	26,36	10,14	ºC
Temperatura del pretractament tèrmic de la biomassa microlgal	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	ºC
Calor requerida per a la codigestió anaeròbia	568,24	601,45	1.334,97	1.217,63	1.163,78	875,04	605,21	439,44	546,04	639,74	507,93	560,91	755,03	1.334,97	439,44	kWh/dia

CONSUM ENERGÈTIC DIGESTOR ANAERÒBIC (ELECTRICITAT)																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Consum específic d'energia per bombar	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	1.800	KJ/m^3
Consum específic d'energia per agitar	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	$KJ/m^3 \cdot dia$
Electricitat requerida per a la codigestió anaeròbia	73,13	73,13	87,79	87,79	88,34	88,34	88,34	80,61	80,61	80,61	73,13	73,13	81,25	88,34	73,13	kWh/dia

RECIRCULACIÓ DE BIOMASSA MICROALGAL																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Percentatge de recirculació de la biomassa microalgal	10	10	2	2	2	2	2	10	10	10	10	10	7	10	2	%
Cabal de recirculació de la biomassa microalgal	0,36	0,36	0,28	0,28	0,29	0,29	0,29	0,89	0,89	0,89	0,36	0,36	0,46	0,89	0,28	m³/dia

1.8. EMISSIONS A L'AIGUA

Paràmetre		**Valors**							**Unitats**
		Període 1 (Març-Abril)	Període 2 (Maig-Juliol)	Període 3 (Agost-Octubre)	Període 4 (Novembre-Març)	Promig	Màxim	Mínim	
Emissions de DQO	Concentració de DQO a l'afluent	381,00	463,00	318,00	363,00	381,25	463,00	318,00	g/m³ aigua
	Eficiència d'eliminació	80				80	80	80	%
	Concentració de DQO a l'efluent	76,20	92,60	63,60	72,60	76,25	92,60	63,60	g/m³ aigua
Emissions de N	Concentració de N-NH_4^+ a l'afluent	30,00	33,00	36,00	26,00	31,25	36,00	26,00	g/m³ aigua
	Eficiència d'eliminació	95		99		97	99	95	%
	Concentració de N-NH_4^+ a l'efluent	0,90	0,99	1,08	0,78	0,94	1,08	0,78	g/m³ aigua
	Percentatge de NH_4 a l'efluent respecte de N_{total}	10				10	10	10	%
	Contingut de N_{total} a l'efluent	9,00	9,90	10,80	7,80	9,38	10,80	7,80	g/m³ aigua
Emissions de SST	Concentració de SST a l'efluent	23,00	25,00	30,00	18,00	24,00	30,00	18,00	g/m³ aigua
Emissions de P	Concentració de P a l'afluent	5				5	5	5	g/m³ aigua
		9.750				9.750	9.750	9.750	g/dia
	Contingut de SST al digestat	3				3	3	3	%
	Quantitat de digestat	26.698,48				26.698,48	26.698,48	26.698,48	kg/dia
	Concentració de P al digestat	3,20				3,20	3,20	3,20	g/kg ST
		0,10				0,10	0,10	0,10	g/kg digestat
		2.563,05				2.563,05	2.563,05	2.563,05	g/dia
	Concentració de P a l'efluent	7.186,95				7.186,95	7.186,95	7.186,95	g/dia
		3,69				3,69	3,69	3,69	g/m³ aigua

1.9. EMISSIONS A L'AIRE

Paràmetre	Valors				Unitats
	Període 1 (Març-Abril)	Període 2 (Maig-Juliol)	Període 3 (Agost-Octubre)	Període 4 (Novembre-Març)	
Percentatge de NH_4 a l'afluent	80				%
Percentatge de NO_x a l'afluent	0				%
Percentatge de N_{total} oxidat a l'afluent	20				%
Contingut de N_{total} a l'afluent	39,06				g/m³ aigua
	76,17				kg/dia
Percentatge de NH_4 a l'efluent	10				%
Percentatge de NO_x a l'efluent	48				%
Percentatge de N_{total} oxidat a l'efluent	42				%
Contingut de N_{total} a l'efluent	9,38				g/m³ aigua
	18,28				kg/dia
Contingut de N_{total} al digestat	50,47				kg/dia
NH_4 que es volatilitza	7,42				kg/dia
	3,80				g/m³ aigua

1.10. APLICACIÓ DEL DIGESTAT

	Paràmetre	Valors	Unitats	Referències bibliogràfiques
	Densitat de la biomassa microalgal	1.005	kg/m³	
	Cabal total de digestat	26,57	m³/dia	
		26.698,48	kg/dia	
		13,69	kg/m³ aigua	
	Contingut de N_{total} al digestat	1,90	g/L digestat	
		1,891E+00	g/kg digestat	
		2,588E+01	g/m³ aigua	
EMISSIONS A L'AIRE	Contingut de NH_3 al digestat respecte de N_{total}	25	%	Hospido et al., 2008 Hobson et al., 2000 Lundin et al., 2000
	Contingut de N_2O al digestat respecte de N_{total}	1	%	
	NH_3	4,726E-01	g/kg digestat	
		6,471E+00	g/m³ aigua	
	N_2O	1,891E-02	g/kg digestat	
		2,588E-01	g/m³ aigua	

	Paràmetre	Valors	Unitats	Referències bibliogràfiques
	Contingut de ST al digestat	3	%	Solé-Bundó et al., 2017
EMISSIONS AL SÒL	Cd	8,60	mg/kg ST	
		2,580E-04	g/kg digestat	
		3,532E-03	g/m³ aigua	
	Cu	491,00	mg/kg ST	
		1,473E-02	g/kg digestat	
		2,017E-01	g/m³ aigua	
	Pb	221,00	mg/kg ST	
		6,630E-03	g/kg digestat	
		9,077E-02	g/m³ aigua	
	Zn	2.202,00	mg/kg ST	
		6,606E-02	g/kg digestat	
		9,045E-01	g/m³ aigua	
	Ni	101,00	mg/kg ST	
		3,030E-03	g/kg digestat	
		4,149E-02	g/m³ aigua	
	Cr	127,00	mg/kg ST	
		3,810E-03	g/kg digestat	
		5,216E-02	g/m³ aigua	
	Hg	1,10	mg/kg ST	
		3,300E-05	g/kg digestat	
		4,518E-04	g/m³ aigua	

2. ESCENARI 2

2.0. DADES DE PARTIDA

INPUT
OUTPUT

Paràmetre	Valors	Unitats	Rang de valors acceptables
Població servida	10.000	hab	
Dotació	195	L/hab·dia	*120 - 300*
Cabal de l'afluent	1.950.000	L/dia	
	1.950	m³/dia	
	81,25	m³/h	

2.1. HRAP

Paràmetre	Valors	Unitats	Comentaris
	HRAP 3 dies		
Taxa d'emissió per persona	60	g DBO/hab·dia	
Càrrega contaminant	600	kg DBO/dia	
Velocitat de càrrega orgànica	280	kg DBO/ha·dia	
Eficiència del pretractament	1	-	*No hi ha pretractament*
Càrrega contaminant de l'afluent	600	kg DBO/dia	
Superfície total	2,14	ha	
	21.428,57	m²	
Forma	-	-	*Ovalada*
Cabal d'entrada	81,25	m³/h	*Cabal de l'afluent*
Temps de retenció hidràulica	3	dia	*Mateix TRH tot l'any = 3 dies = 2 HRAP*
Volum de tractament	5.850	m³	
Nre. de HRAP	2	-	
Volum de tractament 1 HRAP	2.925	m³	
Profunditat d'aigua	0,20	m	
Superfície 1 HRAP	14.625	m²	
Amplada 1 HRAP	12	m	*7 - 12*
Llargada 1 HRAP	1.218,75	m	
Perímetre 1 HRAP	2.461,50	m	*Considerant HRAP en forma rectangular*
Profunditat dels murs	0,30	m	*10 cm més que la profunditat de tractament*
Espessor de formigó	0,2	m	
Volum de formigó als murs perimetrals	295,38	m³	

Paràmetre	Valors	Unitats	Comentaris
	HRAP 3 dies		
Volum de formigó a la base	5850	m^3	
Volum total de formigó	6.145,38	m^3	
Massa d'acer	491.630,40	kg	
Superfície total de les HRAP	29.250	m^2	
Massa d'acer a la pala d'agitació 1 HRAP	381,36	kg	
Massa de fibra de vidre a la pala d'agitació 1 HRAP	976,52	kg	
Nre. de pales d'agitació	2	-	
Massa d'acer total a les pales d'agitació	762,71	kg	
Massa de fibra de vidre total a les pales d'agitació	1.953,04	kg	

	Paràmetre	Valors	Unitats	Comentaris
PÈRDUA DE CÀRREGA CANAL I CANVIS DE SENTIT	Superfície 1 HRAP	14.625	m^2	
	Amplada	12	m	
	Llargada	1.218,75	m	
	Coeficient de rugositat de Manning	0,025	-	
	Profunditat aigua	0,20	m	$\Delta d_1 = \frac{v^2 \cdot l}{\left(\frac{1,486}{n}\right)^2 \cdot \left(\frac{h \cdot a}{a+2h}\right)^{1,26}}$
	Velocitat aigua	0,15	m/s	
	Pèrdua de càrrega canal 1 HRAP	0,061	m	
	Nre. de canvis de sentit	2	-	
	Pèrdua de càrrega canvi de sentit 1 HRAP	0,0023	m	$\Delta d_2 = \frac{v^2}{2g}$ $\Delta d = \Delta d_1 + \Delta d_2$
	Pèrdua de càrrega total 1 HRAP	0,0638	m	

	Paràmetre	Valors	Unitats	Comentaris
CONSUM ENERGÈTIC HRAP (1)	Cabal d'aigua en moviment	0,36	m^3/s	
	Pes específic de l'aigua a 20ºC	9,78	KN/m^3	
	Pèrdua de càrrega total 1 HRAP	0,0638	m	
	Eficiència de la pala d'agitació	0,5	-	*0,2- 0,6*
	Nre. HRAP	2	-	
	Potència requerida	0,8979	kW	
		0,1535	W/m^3	
	Consum d'energia	10,0562	kWh/dia·ha	*Associat al moviment de la pala d'agitació*
		1,0056	Wh/dia·m^2	
		3,6836	Wh/dia·m^3	

CONSUM ENERGÈTIC HRAP (2)																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Energia (electricitat) requerida a les HRAP	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	21,55	kWh/dia

PRODUCCIÓ DE BIOMASSA MICROALGAL																
Paràmetre	**Valors**															**Unitats**
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Producció mitjana de biomassa microalgal	15	16	23	24	26	30	30	26	25	23	20	18	23	30	15	g SST/m²·dia
Contingut de SV a la biomassa microalgal	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	%
Producció mitjana de biomassa microalgal	13,50	14,40	20,70	21,60	23,40	27,00	27,00	23,40	22,50	20,70	18,00	16,20	20,70	27,00	13,50	g SV/m²·dia
Eficiència de separació del sistema	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	%
Producció recol·lecció de biomassa microlgal	12,42	13,25	19,04	19,87	21,53	24,84	24,84	21,53	20,70	19,04	16,56	14,90	19,04	24,84	12,42	g SV/m²·dia
Producció diària de biomassa microalgal	266,14	283,89	408,09	425,83	461,31	532,29	532,29	461,31	443,57	408,09	354,86	319,37	408,09	532,29	266,14	kg SV/dia
Concentració de biomassa microalgal a la mescla	0,08	0,08	0,09	0,10	0,11	0,12	0,12	0,12	0,11	0,10	0,09	0,08	0,10	0,12	0,08	% SST
SST a la biomassa microalgal recol·lectada	1,60	1,60	1,80	2,00	2,20	2,40	2,40	2,40	2,20	2,00	1,80	1,60	2,00	2,40	1,60	%
Concentració de SV a la biomassa microalgal	14,40	14,40	16,20	18,00	19,80	21,60	21,60	21,60	19,80	18,00	16,20	14,40	18,00	21,60	14,40	g SV/L
Cabal de biomassa microalgal	18,48	19,71	25,19	23,66	23,30	24,64	24,64	21,36	22,40	22,67	21,90	22,18	22,51	25,19	18,48	m³/dia
Densitat de la biomassa microalgal (= H_2O)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	kg/m³
Producció de biomassa microalgal	9,48	10,11	12,92	12,13	11,95	12,64	12,64	10,95	11,49	11,63	11,23	11,37	11,54	12,92	9,48	kg/m³

2.2. DECANTADOR SECUNDARI

Paràmetre	Valors	Unitats	Comentaris
Forma	-	-	*Cilíndrica i cònica*
Cabal d'entrada	81,25	m^3/h	*Cabal de l'afluent*
Temps de retenció hidràulica	3	h	
Volum	243,75	m^3	
Secció cònica	6	%	
Espessor de formigó	0,20	m	
Profunditat	2,50	m	
Profunditat de la secció la cònica	0,20	m	
Profunditat de la secció cilíndrica	2,30	m	
Diàmetre	11,45	m	
Generatriu exterior del con	5,93	m	
Superfície exterior del con	110,38	m^2	
Superfície exterior del cilindre	85,63	m^2	
Superfície exterior	196,01	m^2	
Volum de formigó	39,20	m^3	
Massa d'acer	3.136,17	kg	

Verificacions	Valors	Unitats	Comentaris
Superfície en planta	105,98	m^2	*Considerant només la secció cilíndrica*
Càrrega hidràulica superficial	18,40	$m^3/dia \cdot m^2$	*Condicions seques: 16-29 $m^3/dia \cdot m^2$;*
	0,77	$m^3/h \cdot m^2$	*Condicions òptimes: 41-65 $m^3/dia \cdot m^2$*

CONSUM ENERGÈTIC DECANTADOR SECUNDARI	Paràmetre	Valors	Unitats
	Cabal biomassa de microalgues	22,51	m^3/dia
	Consum específic energia	1.800	kJ/m^3
	Energia (electricitat) bomba de fangs	40,52	MJ/dia
		11,256	kWh/dia

Paràmetre	Valors															Unitats
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Addició de floculant	8	8	9	10	11	12	12	12	11	10	9	8	10	12	8	g/m^3 aigua

2.3. CENTRÍFUGA

Paràmetre	Valors	Unitats	Referència bibliogràfica
Acer	550	kg	Cullell, 2015

Paràmetre	Valors															Unitats
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
Afluent de biomassa microalgal	9,48	10,11	12,92	12,13	11,95	12,64	12,64	10,95	11,49	11,63	11,23	11,37	11,54	12,92	9,48	kg/m³ aigua
Efluent de biomassa microalgal	0,95	1,01	1,29	1,21	1,19	1,26	1,26	1,10	1,15	1,16	1,12	1,14	1,15	1,29	0,95	kg/m³ aigua
SST a l'afluent	1,60	1,60	1,80	2,00	2,20	2,40	2,40	2,40	2,20	2,00	1,80	1,60	2,00	2,40	1,60	%
SST a l'efluent	16	16	18	20	22	24	24	24	22	20	18	16	20	24	16	%
Consum d'energia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	kWh/m³ fang
Densitat de la biomassa microalgal (= H_2O)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	kg/m³
Energia (electricitat) requerida a la centrífuga	0,009	0,010	0,013	0,012	0,012	0,013	0,013	0,011	0,011	0,012	0,011	0,011	0,012	0,013	0,009	kWh/m³ aigua
	18,48	19,71	25,19	23,66	23,30	24,64	24,64	21,36	22,40	22,67	21,90	22,18	22,51	25,19	18,48	kWh/dia

2.4. EMISSIONS A L'AIGUA

<table>
<tr><th colspan="2">Paràmetre</th><th colspan="12">Valors</th><th>Unitats</th></tr>
<tr><td></td><td></td><td>GENER</td><td>FEBRER</td><td>MARÇ</td><td>ABRIL</td><td>MAIG</td><td>JUNY</td><td>JULIOL</td><td>AGOST</td><td>SETEMBRE</td><td>OCTUBRE</td><td>NOVEMBRE</td><td>DESEMBRE</td><td></td></tr>
<tr><td rowspan="3">Emissions DQO</td><td>Concentració de DQO a l'afluent</td><td colspan="12">800</td><td>g/m³ aigua</td></tr>
<tr><td>Eficiència d'eliminació</td><td colspan="12">87,50</td><td>%</td></tr>
<tr><td>Concentració de DQO a l'efluent</td><td colspan="12">100</td><td>g/m³ aigua</td></tr>
<tr><td rowspan="3">Emissions N</td><td>Concentració de N_{total} a l'afluent</td><td colspan="12">50</td><td>g/m³ aigua</td></tr>
<tr><td>Eficiència d'eliminació</td><td colspan="12">96</td><td>%</td></tr>
<tr><td>Concentració de N_{total} a l'efluent</td><td colspan="12">2</td><td>g/m³ aigua</td></tr>
<tr><td rowspan="3">Emissions SST</td><td>Concentració de SST a l'afluent</td><td colspan="12">200</td><td>g/m³ aigua</td></tr>
<tr><td>Eficiència d'eliminació</td><td colspan="12">75</td><td>%</td></tr>
<tr><td>Concentració de SST a l'efluent</td><td colspan="12">50</td><td>g/m³ aigua</td></tr>
<tr><td rowspan="3">Emissions P</td><td>Concentració de P a l'afluent</td><td colspan="12">10</td><td>g/m³ aigua</td></tr>
<tr><td>Eficiència d'eliminació</td><td colspan="12">90</td><td>%</td></tr>
<tr><td>Concentració de P a l'efluent</td><td colspan="12">1</td><td>g/m³ aigua</td></tr>
</table>

2.5. EMISSIONS A L'AIRE

Paràmetre	Valors												Unitats
	GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	
Concentració de N_{total} a l'afluent	50												g/m^3 aigua
Percentatge de NH_4 que es volatilitza	10												%
NH_4 que es volatilitza	5												g/m^3 aigua

2.6. APLICACIÓ DEL BIOFERTILITZANT

	Paràmetre	Valors															Unitats
		GENER	FEBRER	MARÇ	ABRIL	MAIG	JUNY	JULIOL	AGOST	SETEMBRE	OCTUBRE	NOVEMBRE	DESEMBRE	Promig	Màxim	Mínim	
CONSUM ENERGÈTIC	Producció de biofertilitzant	0,95	1,01	1,29	1,21	1,19	1,26	1,26	1,10	1,15	1,16	1,12	1,14	1,15	1,29	0,95	kg/m^3 aigua
	Electricitat necessària	0,02	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020				kWh/m^3 aigua
		39,00	39,00	39,00	39,00	39,00	39,00	39,00	39,00	39,00	39,00	39,00	39,00				kWh/dia
	Calor necessària	0,022	0,024	0,030	0,028	0,028	0,030	0,030	0,026	0,027	0,027	0,026	0,027	0,027	0,030	0,022	kWh/m^3 aigua
		43,26	46,15	58,97	55,38	54,54	57,68	57,68	49,99	52,44	53,07	51,27	51,92	52,70	58,97	43,26	kWh/dia

	Paràmetre	Valors	Unitats	Referències bibliogràfiques
	Contingut de N_{total} al digestat	5,00	g/kg fertilitzant	
		5,77	g/m^3 aigua	
EMISSIONS A L'AIRE	Contingut de NH_3 al digestat respecte N_{total}	25%	%	Hospido et al., 2008 Hobson et al., 2000 Lundin et al., 2000
	Contingut de N_2O al digestat respecte N_{total}	1%	%	
	NH_3	1,250E+00	g/kg fertilitzant	
		1,443E+00	g/m^3 aigua	
	N_2O	5,000E-02	g/kg fertilitzant	
		5,772E-02	g/m^3 aigua	
EMISSIONS AL SÒL	Cd	0,30	mg/kg fertilitzant	
		3,000E-04	g/kg fertilitzant	
		3,463E-04	g/m^3 aigua	
	Cu	40,00	mg/kg fertilitzant	
		4,000E-02	g/kg fertilitzant	
		4,618E-02	g/m^3 aigua	
	Pb	20,00	mg/kg fertilitzant	
		2,000E-02	g/kg fertilitzant	
		2,309E-02	g/m^3 aigua	
	Zn	10,00	mg/kg fertilitzant	

		1,000E-02	g/kg fertilitzant	
		1,154E-02	g/m³ aigua	
	Ni	10,00	mg/kg fertilitzant	
		1,000E-02	g/kg fertilitzant	
		1,154E-02	g/m³ aigua	
	Cr	30,00	mg/kg fertilitzant	
		3,000E-02	g/kg fertilitzant	
		3,463E-02	g/m³ aigua	
	Hg	0,20	mg/kg fertilitzant	
		2,000E-04	g/kg fertilitzant	
		2,309E-04	g/m³ aigua	

B. EDAR DE FANGS ACTIVATS

TAULA DE CONTINGUTS

1. ESCENARI 3

1.0. DADES DE PARTIDA

INPUT
OUTPUT

Paràmetre	Valors	Unitats	Rang de valors acceptables
Població servida	10.000	hab	
Dotació	195	L/hab·dia	*120 - 300*
Cabal de l'afluent	1.950.000	L/dia	
	1.950	m^3/dia	
	81,25	m^3/h	

1.1. DECANTADOR PRIMARI

Paràmetre	Valors	Unitats	Comentaris/Rang de valors acceptables
Forma	-	-	*Rectangular*
Cabal d'entrada	81,25	m^3/h	*Cabal de l'afluent*
Temps de retenció hidràulica	2,50	h	*1,50 - 2,50*
Volum	203,13	m^3	
Profunditat	3,50	m	*3 - 4,50*
Superfície	58,04	m^2	
Relació llargada/amplada	3,00	-	*3 - 8*
Amplada	4,40	m	
Llargada	13,19	m	
Espessor de formigó	0,20	m	
Volum de formigó	36,24	m^3	
Massa d'acer	2.899,02	kg	

Verificacions	Valors	Unitats	Rang de valors acceptables
Càrrega hidràulica superficial	33,60	m^3/m^2·dia	*20 - 40*
	1,40	m^3/m^2·h	*1,35 - 2,03*

1.2. REACTOR BIOLÒGIC

Paràmetre	Valors	Unitats	Rang de valors acceptables
Forma	-	-	*Cilíndrica*
Cabal d'entrada	81,25	m^3/h	*Cabal de l'afluent*
Temps de retenció hidràulica	6	h	*4 - 6*
Volum	487,50	m^3	
Profunditat	10,00	m	
Superfície	48,75	m^2	
Radi	3,94	m	
Espessor de formigó	0,20	m	
Volum de formigó	59,25	m^3	
Massa d'acer	4.740,16	kg	

1.3. DECANTADOR SECUNDARI

Paràmetre	Valors	Unitats	Comentaris/Rang valors acceptables
Forma	-	-	*Cilíndrica i cònica*
Cabal d'entrada	81,25	m^3/h	*Cabal de l'afluent*
Temps de retenció hidràulica	2	h	*1 - 2*
Volum	162,50	m^3	
Secció cònica	6	%	
Espessor de formigó	0,20	m	
Profunditat total	2,50	m	
Profunditat de la secció cònica	0,20	m	
Profunditat de la secció cilíndrica	2,30	m	
Diàmetre	9,35	m	
Generatriu exterior del con	4,88	m	
Superfície exterior del con	74,73	m^2	
Superfície exterior del cilindre	70,45	m^2	
Superfície exterior total	145,18	m^2	
Volum de formigó	29,04	m^3	
Massa d'acer	2.322,81	kg	

Verificacions	Valors	Unitats	Comentaris
Superfície en planta	70,65	m^2	*Considerant només la secció cilíndrica*
Càrrega hidràulica superficial	27,60	$m^3/m^2 \cdot dia$	*Condicions seques: 16-29 $m^3/dia \cdot m^2$;*
	1,15	$m^3/m^2 \cdot h$	*Condicions òptimes: 41-65 $m^3/dia \cdot m^2$*

1.4. CONSUM ENERGÈTIC

Paràmetre	Valors	Unitats
Energia requerida pel funcionament de la planta	1.735,50	kWh/dia

1.5. SUPERFÍCIE DE TRACTAMENT

Paràmetre	Valors	Unitats
Superfície específica	0,60	m^2/HE
Superfície de tractament	6.000	kWh/dia

ANNEX 2.

TREBALLS DE L'ANÀLISI DEL CICLE DE VIDA

A. INVENTARI

TAULA DE CONTINGUTS

1. ESCENARIS PRINCIPALS

1.1. ESCENARI 1

OCUPACIÓ DEL TERRENY				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Ocupació del terreny	Land occupation	39.000,00	m^2	2,740E-03

DECANTADOR PRIMARI				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	36,24	m^3	2,546E-06
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	2.899,02	kg	2,037E-04

HRAP				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	8.459,60	m^3	5,943E-04
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	676.768,00	kg	4,754E-02
Acer (pala d'agitació)	Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1.525,42	kg	1,072E-04
Fibra de vidre (pala d'agitació)	Glass fibre {GLO}| market for | Alloc Def, S	3.906,08	kg	2,744E-04
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Acer (pala d'agitació)	Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1.525,42	kg	1,072E-04

DECANTADOR SECUNDARI				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	39,20	m^3	2,754E-06
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	3.136,17	kg	2,203E-04

ESPESSIDOR				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	2,53	m^3	1,779E-07
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	202,63	kg	1,423E-05

PRETRACTAMENT TÈRMIC				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	3,94	m^3	2,770E-07
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	315,39	kg	2,216E-05

DIGESTOR ANAERÒBIC				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	139,30	m^3	9,786E-06
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	11.144,05	kg	7,829E-04

CONSUM ENERGÈTIC (OPERACIÓ)				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Electricitat decantador primari	Electricity, medium voltage {ES}| market for | Alloc Def, S	62.847,53	kWh	4,415E-03
Electricitat HRAP	Electricity, medium voltage {ES}| market for | Alloc Def, S	161.140,20	kWh	1,132E-02
Electricitat decantador secundari (bomba)	Electricity, medium voltage {ES}| market for | Alloc Def, S	34.121,30	kWh	2,397E-03
Electricitat decantador secundari (recirculació)	Electricity, medium voltage {ES}| market for | Alloc Def, S	1.686,85	kWh	1,185E-04
Calor digestor anaeròbic (inclou pretractament tèrmic)	Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	5.511.792,00	kWh	3,872E-01
Electricitat digestor anaeròbic	Electricity, medium voltage {ES}| market for | Alloc Def, S	593.172,45	kWh	4,167E-02

EMISSIONS A L'AIGUA (EFLUENT)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Emissions DQO	Emission to water COD	1.085.418.750,00	g	7,625E+01
Emissions SST	Emission to water TSS	341.640.000,00	g	2,400E+01
Emissions N	Emission to water N	133.453.125,00	g	9,375E+00
Emissions P	Emission to water P	52.470.210,00	g	3,686E+00

EMISSIONS A L'AIRE (HRAP)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Emissions NH_3	Emission to air NH_3	54.135.705,00	g	3,803E+00

APLICACIÓ DEL DIGESTAT				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Digestat	Digestate	194.877.150,00	kg	1,369E+01

N_{total} evitat	Avoided product	1,891E+00	g/kg digestat	2,588E+01	g/m³ aigua
NH_3	Emissions to air	4,726E-01	g/kg digestat	6,471E+00	g/m³ aigua
N_2O		1,891E-02	g/kg digestat	2,588E-01	g/m³ aigua
Cd	Emissions to soil	2,580E-04	g/kg digestat	3,532E-03	g/m³ aigua
Cu		1,473E-02	g/kg digestat	2,017E-01	g/m³ aigua
Pb		6,630E-03	g/kg digestat	9,077E-02	g/m³ aigua
Zn		6,606E-02	g/kg digestat	9,045E-01	g/m³ aigua
Ni		3,030E-03	g/kg digestat	4,149E-02	g/m³ aigua
Cr		3,810E-03	g/kg digestat	5,216E-02	g/m³ aigua
Hg (value <)		3,300E-05	g/kg digestat	4,518E-04	g/m³ aigua

TRANSPORT DEL DIGESTAT				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Transport digestat	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	3.897.543.000,00	kgkm	2,738E+02

ENERGIA EVITADA (COGENERACIÓ BIOGÀS)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Biogàs (co-producte)	Biogas coproduct	3.138.817,50	m^3	2,205E-01

Producció de calor	3,850E+00	kWh/m^3 biogas	8,489E-01	kWh/m^3 aigua
Producció d'electricitat	2,450E+00	kWh/m^3 biogas	5,402E-01	kWh/m^3 aigua

1.2. ESCENARI 2

OCUPACIÓ DEL TERRENY				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Ocupació del terreny	Land occupation	29.250,00	m^2	2,055E-03

HRAP				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	6.145,38	m^3	4,317E-04
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	491.630,40	kg	3,454E-02
Acer (paddle wheel)	Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	762,71	kg	5,358E-05
Fibra de vidre (paddle wheel)	Glass fibre {GLO}| market for | Alloc Def, S	1.953,04	kg	1,372E-04
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Acer (paddle wheel)	Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	762,71	kg	5,358E-05

DECANTADOR SECUNDARI				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó - Estructura	Concrete, normal {GLO}| market for | Alloc Def, S	39,20	m^3	2,754E-06
Acer - Armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	3.136,17	kg	2,203E-04

CENTRÍFUGA				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Acer	Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	550,00	kg	3,864E-05
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Acer	Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	550,00	kg	3,864E-05

CONSUM ENERGÈTIC (OPERACIÓ)				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Electricitat HRAP	Electricity, medium voltage {ES}| market for | Alloc Def, S	157.296,75	kWh	1,105E-02
Electricitat decantador secundari	Electricity, medium voltage {ES}| market for | Alloc Def, S	82.164,42	kWh	5,772E-03
Electricitat centrífuga	Electricity, medium voltage {ES}| market for | Alloc Def, S	164.271,90	kWh	1,154E-02
Calor producció biofertilitzant	Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	384.629,70	kWh	2,702E-02
Electricitat producció biofertilitzant	Electricity, medium voltage {ES}| market for | Alloc Def, S	284.700,00	kWh	2,000E-02

ADDICIÓ DE PRODUCTES QUÍMICS (OPERACIÓ)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Floculant	Chemical, organic {GLO}| market for | Alloc Def, S	142.350.000,00	g	1,000E+01

EMISSIONS A L'AIGUA (EFLUENT)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Emissions DQO	Emission to water COD	1.423.500.000,00	g	1,000E+02
Emissions SST	Emission to water TSS	711.750.000,00	g	5,000E+01
Emissions N	Emission to water N	28.470.000,00	g	2,000E+00
Emissions P	Emission to water P	14.235.000,00	g	1,000E+00

EMISSIONS A L'AIRE (HRAP)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Emissions NH_3	Emission to air NH_3	71.175.000,00	g	5,000E+00

APLICACIÓ DEL BIOFERTILITZANT				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Biofertilitzant	Biofertilizer	16.427.190,00	kg	1,154E+00

N_{total} evitat	Avoided product	5,000E+00	g/kg fertilitzant	5,772E+00	g/m³ aigua
NH_3	Emissions to air	1,250E+00	g/kg fertilitzant	1,443E+00	g/m³ aigua
N_2O		5,000E-02	g/kg fertilitzant	5,772E-02	g/m³ aigua
Cd	Emissions to soil	3,000E-04	g/kg fertilitzant	3,463E-04	g/m³ aigua
Cu		4,000E-02	g/kg fertilitzant	4,618E-02	g/m³ aigua
Pb		2,000E-02	g/kg fertilitzant	2,309E-02	g/m³ aigua
Zn		1,000E-02	g/kg fertilitzant	1,154E-02	g/m³ aigua
Ni		1,000E-02	g/kg fertilitzant	1,154E-02	g/m³ aigua
Cr		3,000E-02	g/kg fertilitzant	3,463E-02	g/m³ aigua
Hg (value <)		2,000E-04	g/kg fertilitzant	2,309E-04	g/m³ aigua

TRANSPORT DEL BIOFERTILITZANT				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Transport biofertilitzant	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	328.686.150,00	kgkm	2,309E+01

1.3. ESCENARI 3

OCUPACIÓ DEL TERRENY				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Ocupació del terreny	Land occupation	6.000,00	m^2	4,215E-04

OBRA CIVIL				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Formigó-estructura	Concrete, normal {GLO}| market for | Alloc Def, S	124,52	m^3	8,748E-06
Acer-armadura	Reinforcing steel {GLO}| market for | Alloc Def, S	9.961,99	kg	6,998E-04

CONSUM ENERGÈTIC (OPERACIÓ)				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Electricitat funcionament planta	Electricity, medium voltage {ES}| market for | Alloc Def, S	12.669.150,00	kWh	8,900E-01

ADDICIÓ DE PRODUCTES QUÍMICS (OPERACIÓ)				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Polielectròlit	Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	28.185.300,00	g	1,980E+00
Coagulant	Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	45.267.300,00	g	3,180E+00

EMISSIONS A L'AIGUA (EFLUENT)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Emissions DQO	Emission to water COD	1.779.375.000,00	g	1,250E+02
Emissions SST	Emission to water TSS	498.225.000,00	g	3,500E+01
Emissions N	Emission to water N	213.525.000,00	g	1,500E+01
Emissions P	Emission to water P	2.8470.000,00	g	2,000E+00

EMISSIONS A L'AIRE (REACTOR DE FANGS ACTIVATS)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Emissions CO_2	Emission to air CO_2	2.419.950,00	g	1,700E-01
Emissions N_2O	Emission to air N_2O	1.565.850,00	g	1,100E-01

TRANSPORT DELS FANGS				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Transport fangs	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	529.542.000,00	kgkm	3,720E+01

RESIDUS A TRACTAR (FANGS)				
Item	**Materials/Assemblies**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Fangs	Raw sewage sludge	17.651.400,00	kg	1,240E+00

2. ANÀLISI DE SENSIBILITAT

A continuació s'adjunten els valors dels paràmetres modificats a l'anàlisi de sensibilitat. Cal tenir en compte que per cadascun dels escenaris plantejats només varia el valor sombrejat i la resta coincideixen amb els de l'apartat 1. ESCENARIS PRINCIPALS.

2.1. ESCENARI 1

2.1.1. Emissions a l'aigua de N (efluent)

EMISSIONS A L'AIGUA (EFLUENT)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Emissions DQO	Emission to water COD	g	7,625E+01
Emissions SST	Emission to water TSS	g	2,400E+01
Emissions N	Emission to water N	g	1,031E+01
Emissions P	Emission to water P	g	3,686E+00

2.1.2. Emissions a l'aire de NH_3 (HRAP)

EMISSIONS A L'AIRE (HRAP)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Emissions NH_3	Emission to air NH_3	g	4,183E+00

2.1.3. Emissions a l'aire de NH_3 i de N_2O (digestat)

APLICACIÓ DEL DIGESTAT			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Digestat	Digestate	kg	1,369E+01

N_{total} evitat	Avoided product	1,891E+00	g/kg digestat	2,588E+01	g/m³ aigua
NH_3	Emissions to air	5,199E-01	g/kg digestat	7,118E+00	g/m³ aigua
N_2O		2,080E-02	g/kg digestat	2,847E-01	g/m³ aigua
Cd	Emissions to soil	2,580E-04	g/kg digestat	3,532E-03	g/m³ aigua
Cu		1,473E-02	g/kg digestat	2,017E-01	g/m³ aigua
Pb		6,630E-03	g/kg digestat	9,077E-02	g/m³ aigua
Zn		6,606E-02	g/kg digestat	9,045E-01	g/m³ aigua
Ni		3,030E-03	g/kg digestat	4,149E-02	g/m³ aigua
Cr		3,810E-03	g/kg digestat	5,216E-02	g/m³ aigua
Hg (value <)		3,300E-05	g/kg digestat	4,518E-04	g/m³ aigua

2.1.4. Distància de transport del digestat

TRANSPORT DEL DIGESTAT			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Transport digestat	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	kgkm	3,012E+02

2.1.5. Producció de biogàs

ENERGIA EVITADA (COGENERACIÓ BIOGÀS)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Biogàs (co-producte)	Biogas coproduct	m³	2,425E-01

Producció de calor	3,850E+00	kWh/m³ biogas	9,338E-01	kWh/m³ aigua
Producció d'electricitat	2,450E+00	kWh/m³ biogas	5,942E-01	kWh/m³ aigua

2.2. ESCENARI 2

2.2.1. Emissions a l'aigua de N (efluent)

EMISSIONS A L'AIGUA (EFLUENT)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Emissions DQO	Emission to water COD	g	1,000E+02
Emissions SST	Emission to water TSS	g	5,000E+01
Emissions N	Emission to water N	g	2,200E+00
Emissions P	Emission to water P	g	1,000E+00

2.2.2. Emissions a l'aire de NH_3 (HRAP)

EMISSIONS A L'AIRE (HRAP)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Emissions NH_3	Emission to air NH_3	g	5,500E+00

2.2.3. Emissions a l'aire de NH_3 i de N_2O (biofertilitzant)

APLICACIÓ DEL BIOFERTILITZANT			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Biofertilitzant	Biofertilizer	kg	1,154E+00

N_{total} evitat	Avoided product	5,000E+00	g/kg fertilitzant	5,772E+00	g/m³ aigua
NH_3	Emissions to air	1,375E+00	g/kg fertilitzant	1,587E+00	g/m³ aigua
N_2O		5,500E-02	g/kg fertilitzant	6,350E-02	g/m³ aigua
Cd	Emissions to soil	3,000E-04	g/kg fertilitzant	3,463E-04	g/m³ aigua
Cu		4,000E-02	g/kg fertilitzant	4,618E-02	g/m³ aigua
Pb		2,000E-02	g/kg fertilitzant	2,309E-02	g/m³ aigua
Zn		1,000E-02	g/kg fertilitzant	1,154E-02	g/m³ aigua

Ni		1,000E-02	g/kg fertilitzant	1,154E-02	g/m^3 aigua
Cr		3,000E-02	g/kg fertilitzant	3,463E-02	g/m^3 aigua
Hg (value <)		2,000E-04	g/kg fertilitzant	2,309E-04	g/m^3 aigua

2.2.4. Distància de transport del biofertilitzant

TRANSPORT DEL BIOFERTILITZANT				
Item	**Processes**	**Quantity**	**SimaPro Units**	**Quantity/FU**
Transport biofertilitzant	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	328.686.150,00	kgkm	2,540E+01

3. AVALUACIÓ D'ESTACIONALITAT

A continuació s'adjunten els valors dels paràmetres modificats a l'avaluació d'estacionalitat. Cal tenir en compte que per cadascun dels escenaris plantejats només varia el valor sombrejat i la resta coincideixen amb els de l'apartat 1. ESCENARIS PRINCIPALS.

3.1. ESCENARI 1

3.1.1. Hivern (producció mínima de biomassa microalgal)

CONSUM ENERGÈTIC (OPERACIÓ)			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Electricitat decantador primari	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	2,136E-03
Electricitat HRAP	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,132E-02
Electricitat decantador secundari (bomba)	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,160E-03
Electricitat decantador secundari (recirculació)	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	8,263E-05
Calor digestor anaeròbic (inclou pretractament tèrmic)	Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	kWh	1,907E-01
Electricitat digestor anaeròbic	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,005E-02

APLICACIÓ DEL DIGESTAT			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Digestat	Digestate	kg	6,624E+00

N_{total} evitat	Avoided product	1,891E+00	g/kg digestat	1,252E+01	g/m³ aigua
NH_3	Emissions to air	4,726E-01	g/kg digestat	3,131E+00	g/m³ aigua
N_2O		1,891E-02	g/kg digestat	1,252E-01	g/m³ aigua
Cd	Emissions to soil	2,580E-04	g/kg digestat	1,709E-03	g/m³ aigua
Cu		1,473E-02	g/kg digestat	9,757E-02	g/m³ aigua
Pb		6,630E-03	g/kg digestat	4,392E-02	g/m³ aigua

Zn		6,606E-02	g/kg digestat	4,376E-01	g/m³ aigua
Ni		3,030E-03	g/kg digestat	2,007E-02	g/m³ aigua
Cr		3,810E-03	g/kg digestat	2,524E-02	g/m³ aigua
Hg (value <)		3,300E-05	g/kg digestat	2,186E-04	g/m³ aigua

TRANSPORT DEL DIGESTAT			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Transport digestat	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	kgkm	1,325E+02

ENERGIA EVITADA (COGENERACIÓ BIOGÀS)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Biogàs (co-producte)	Biogas coproduct	m³	1,067E-01

Producció de calor	3,850E+00	kWh/m³ biogas	4,107E-01	kWh/m³ aigua
Producció d'electricitat	2,450E+00	kWh/m³ biogas	2,614E-01	kWh/m³ aigua

3.1.2. Estiu (producció màxima de biomassa microalgal)

CONSUM ENERGÈTIC (OPERACIÓ)			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Electricitat decantador primari	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,068E-02
Electricitat HRAP	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,132E-02
Electricitat decantador secundari (bomba)	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	5,798E-03
Electricitat decantador secundari (recirculació)	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	4,132E-04
Calor digestor anaeròbic (inclou pretractament tèrmic)	Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	kWh	8,842E-01
Electricitat digestor anaeròbic	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	5,026E-02

APLICACIÓ DEL DIGESTAT			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Digestat	Digestate	kg	3,312E+01

N_{total} evitat	Avoided product	1,891E+00	g/kg digestat	6,262E+01	g/m³ aigua
NH_3	Emissions to air	4,726E-01	g/kg digestat	1,565E+01	g/m³ aigua
N_2O		1,891E-02	g/kg digestat	6,262E-01	g/m³ aigua
Cd	Emissions to soil	2,580E-04	g/kg digestat	8,545E-03	g/m³ aigua
Cu		1,473E-02	g/kg digestat	4,879E-01	g/m³ aigua
Pb		6,630E-03	g/kg digestat	2,196E-01	g/m³ aigua
Zn		6,606E-02	g/kg digestat	2,188E+00	g/m³ aigua
Ni		3,030E-03	g/kg digestat	1,004E-01	g/m³ aigua
Cr		3,810E-03	g/kg digestat	1,262E-01	g/m³ aigua
Hg (value <)		3,300E-05	g/kg digestat	1,093E-03	g/m³ aigua

TRANSPORT DEL DIGESTAT			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Transport digestat	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	kgkm	6,624E+02

ENERGIA EVITADA (COGENERACIÓ BIOGÀS)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Biogàs (co-producte)	Biogas coproduct	m³	5,334E-01

Producció de calor	3,850E+00	kWh/m³ biogas	2,054E+00	kWh/m³ aigua
Producció d'electricitat	2,450E+00	kWh/m³ biogas	1,307E+00	kWh/m³ aigua

3.2. ESCENARI 2

3.2.1. Hivern (producció mínima de biomassa microalgal)

CONSUM ENERGÈTIC (OPERACIÓ)			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Electricitat HRAP	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,105E-02
Electricitat decantador secundari	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	4,739E-03
Electricitat centrífuga	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	9,478E-03
Calor producció biofertilitzant	Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	kWh	2,219E-02
Electricitat producció biofertilitzant	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,642E-02

ADDICIÓ DE PRODUCTES QUÍMICS (OPERACIÓ)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Floculant	Chemical, organic {GLO}| market for | Alloc Def, S	g	8,000E+01

APLICACIÓ DEL BIOFERTILITZANT			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Biofertilitzant	Biofertilizer	kg	9,478E+01

N_{total} evitat	Avoided product	5,000E+00	g/kg fertilitzant	4,739E+00	g/m³ aigua
NH_3	Emissions to air	1,250E+00	g/kg fertilitzant	1,185E+00	g/m³ aigua
N_2O		5,000E-02	g/kg fertilitzant	4,739E-02	g/m³ aigua
Cd	Emissions to soil	3,000E-04	g/kg fertilitzant	2,843E-04	g/m³ aigua
Cu		4,000E-02	g/kg fertilitzant	3,791E-02	g/m³ aigua
Pb		2,000E-02	g/kg fertilitzant	1,896E-02	g/m³ aigua
Zn		1,000E-02	g/kg fertilitzant	9,478E-03	g/m³ aigua
Ni		1,000E-02	g/kg fertilitzant	9,478E-03	g/m³ aigua
Cr		3,000E-02	g/kg fertilitzant	2,843E-02	g/m³ aigua
Hg (value <)		2,000E-04	g/kg fertilitzant	1,896E-04	g/m³ aigua

TRANSPORT DEL BIOFERTILITZANT			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Transport biofertilitzant	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	kgkm	1,896E+01

3.2.2. Estiu (producció màxima de biomassa microalgal)

CONSUM ENERGÈTIC (OPERACIÓ)			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Electricitat HRAP	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,105E-02
Electricitat decantador secundari	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	6,319E-03
Electricitat centrífuga	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	1,264E-02
Calor producció biofertilitzant	Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	kWh	2,958E-02
Electricitat producció biofertilitzant	Electricity, medium voltage {ES}| market for | Alloc Def, S	kWh	2,189E-02

ADDICIÓ DE PRODUCTES QUÍMICS (OPERACIÓ)			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Floculant	Chemical, organic {GLO}| market for | Alloc Def, S	g	1,200E+01

APLICACIÓ DEL BIOFERTILITZANT			
Item	**Materials/Assemblies**	**SimaPro Units**	**Quantity/FU**
Biofertilitzant	Biofertilizer	kg	1,264E+00

N_{total} evitat	Avoided product	5,000E+00	g/kg fertilitzant	6,319E+00	g/m³ aigua
NH_3	Emissions to air	1,250E+00	g/kg fertilitzant	1,580E+00	g/m³ aigua
N_2O		5,000E-02	g/kg fertilitzant	6,319E-02	g/m³ aigua
Cd	Emissions to soil	3,000E-04	g/kg fertilitzant	3,791E-04	g/m³ aigua
Cu		4,000E-02	g/kg fertilitzant	5,055E-02	g/m³ aigua
Pb		2,000E-02	g/kg fertilitzant	2,527E-02	g/m³ aigua

Zn		1,000E-02	g/kg fertilitzant	1,264E-02	g/m³ aigua
Ni		1,000E-02	g/kg fertilitzant	1,264E-02	g/m³ aigua
Cr		3,000E-02	g/kg fertilitzant	3,791E-02	g/m³ aigua
Hg (value <)		2,000E-04	g/kg fertilitzant	2,527E-04	g/m³ aigua

TRANSPORT DEL BIOFERTILITZANT			
Item	**Processes**	**SimaPro Units**	**Quantity/FU**
Transport biofertilitzant	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	kgkm	2,527E+01

B. TAULES DE RESULTATS

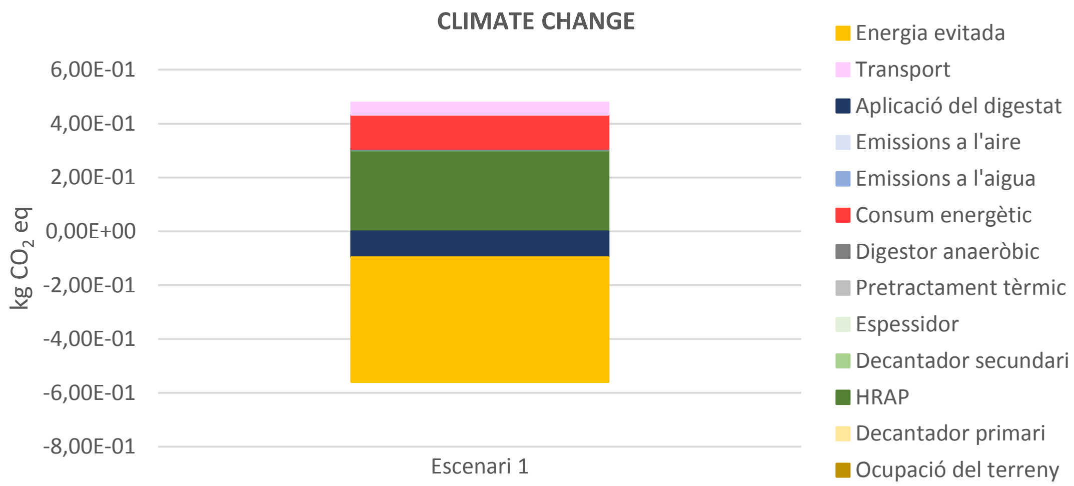
TAULA DE CONTINGUTS

1. RESULTATS DE LA CARACTERITZACIÓ

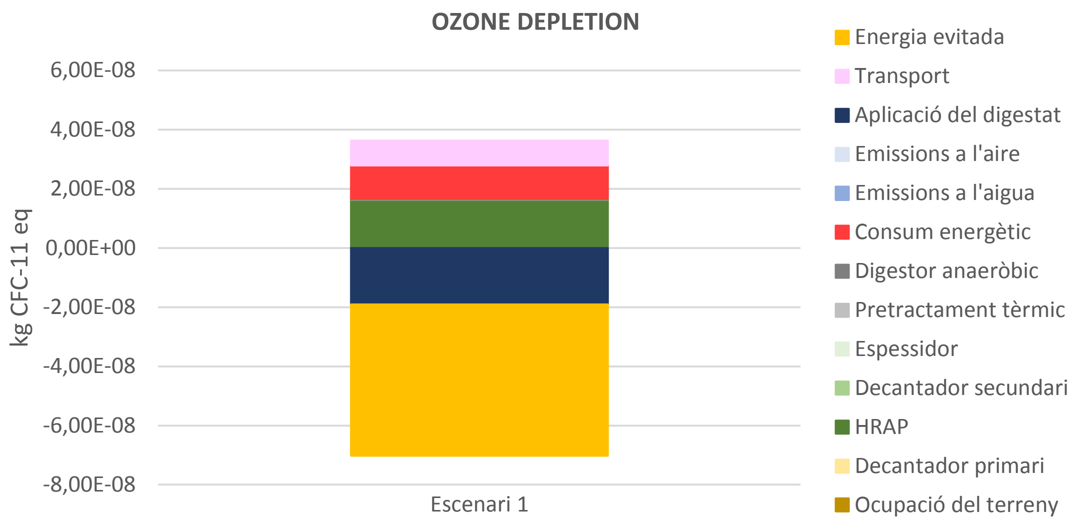
1.1. ESCENARI 1

1.1.0. Base

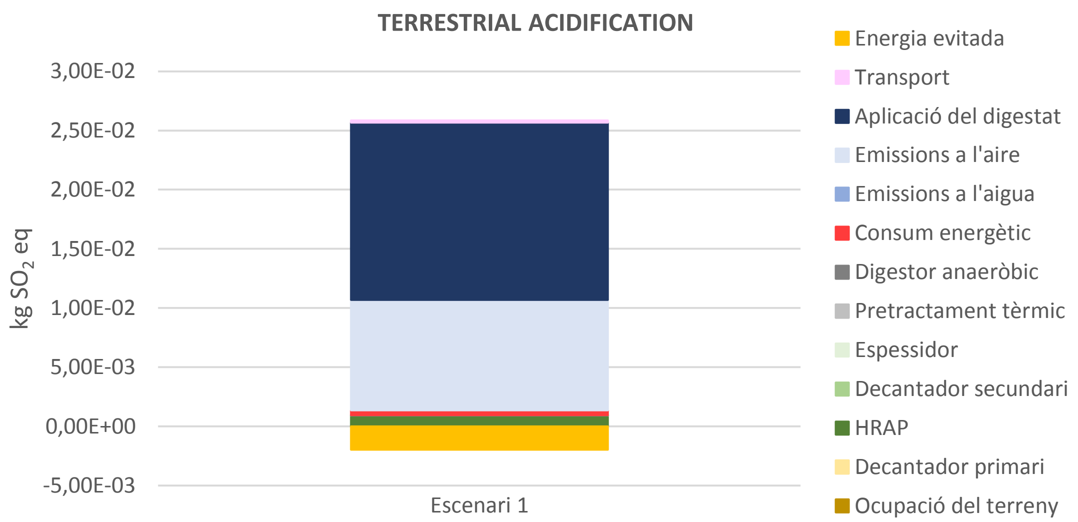
Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**-8,07E-02**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	1,28E-03	0,27%
HRAP	2,99E-01	62,51%
Decantador secundari	1,38E-03	0,29%
Espessidor	8,92E-05	0,02%
Pretractament tèrmic	1,39E-04	0,03%
Digestor anaeròbic	4,91E-03	1,03%
Consum energètic	1,26E-01	26,35%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	-9,64E-02	
Transport	4,55E-02	9,51%
Energia evitada	-4,63E-01	



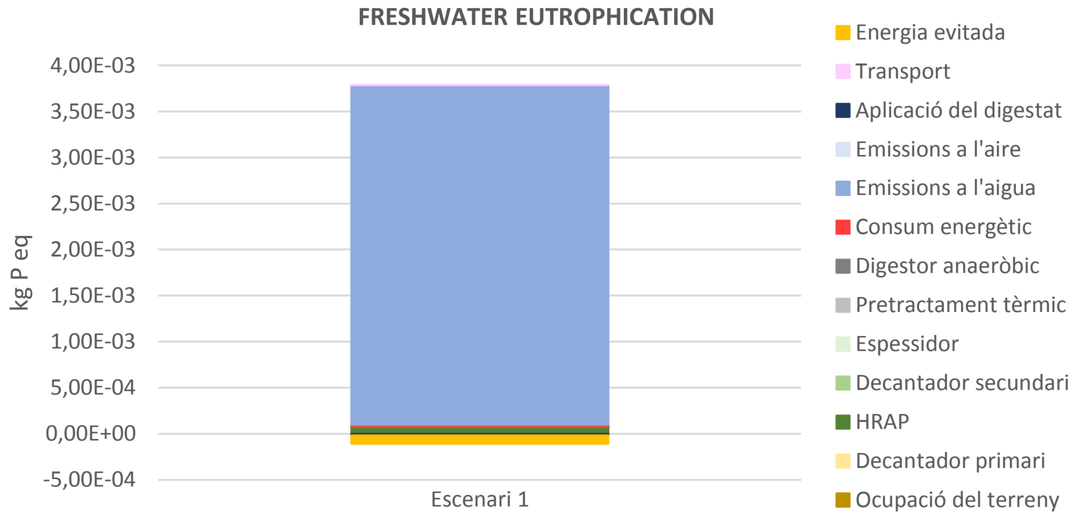
Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**-3,39E-08**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	6,92E-11	0,19%
HRAP	1,62E-08	44,65%
Decantador secundari	7,48E-11	0,21%
Espessidor	4,83E-12	0,01%
Pretractament tèrmic	7,53E-12	0,02%
Digestor anaeròbic	2,66E-10	0,73%
Consum energètic	1,13E-08	30,98%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	-1,91E-08	
Transport	8,43E-09	23,21%
Energia evitada	-5,12E-08	



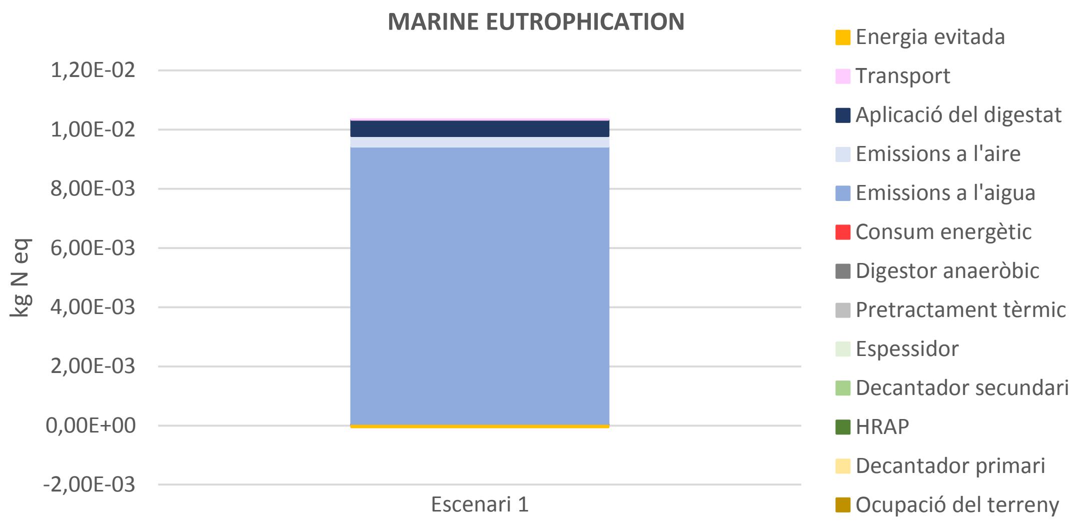
Impact category	Terrestrial Acidification	
Unit	**kg SO_2 eq**	
Total	**2,39E-02**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	3,93E-06	0,02%
HRAP	9,25E-04	3,58%
Decantador secundari	4,26E-06	0,02%
Espessidor	2,75E-07	0,00%
Pretractament tèrmic	4,28E-07	0,00%
Digestor anaeròbic	1,51E-05	0,06%
Consum energètic	4,17E-04	1,61%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	9,32E-03	36,04%
Aplicació del digestat	1,50E-02	57,98%
Transport	1,80E-04	0,70%
Energia evitada	-1,97E-03	



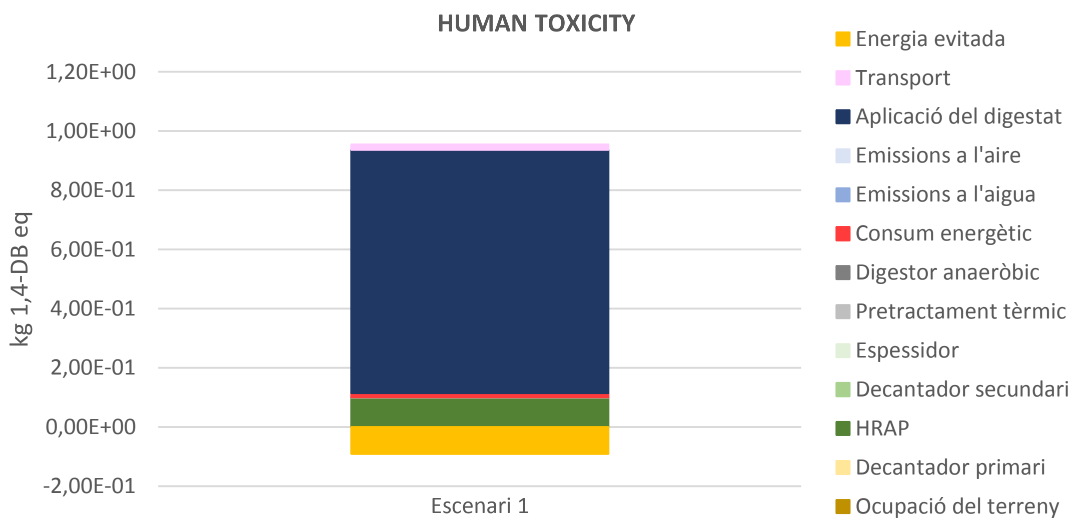
Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**3,68E-03**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	3,50E-07	0,01%
HRAP	8,22E-05	2,17%
Decantador secundari	3,79E-07	0,01%
Espessidor	2,45E-08	0,00%
Pretractament tèrmic	3,81E-08	0,00%
Digestor anaeròbic	1,35E-06	0,04%
Consum energètic	1,24E-05	0,33%
Emissions a l'aigua	3,69E-03	97,35%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	-1,92E-05	
Transport	3,67E-06	0,10%
Energia evitada	-8,84E-05	



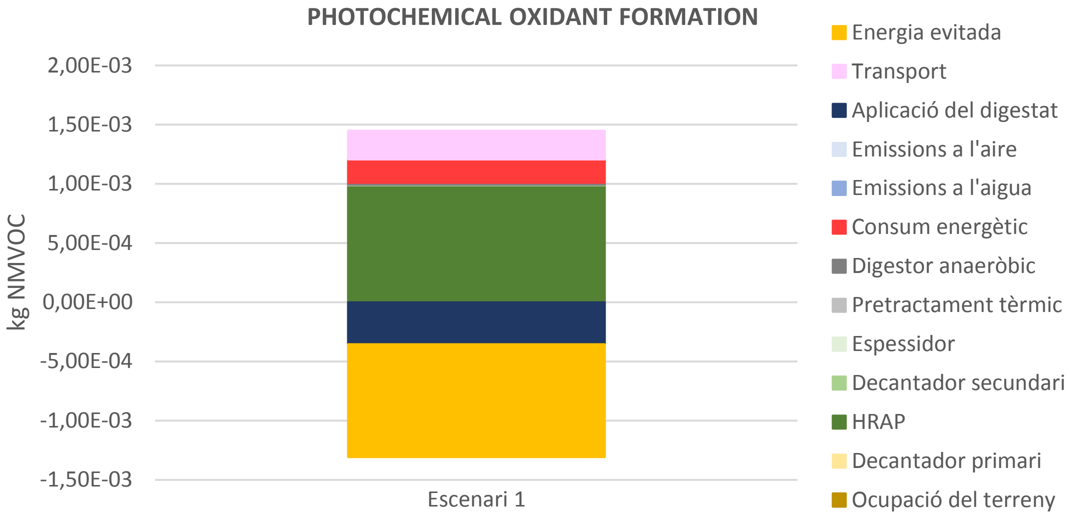
Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**1,03E-02**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	1,79E-07	0,00%
HRAP	4,20E-05	0,41%
Decantador secundari	1,93E-07	0,00%
Espessidor	1,25E-08	0,00%
Pretractament tèrmic	1,94E-08	0,00%
Digestor anaeròbic	6,87E-07	0,01%
Consum energètic	8,88E-06	0,09%
Emissions a l'aigua	9,37E-03	90,66%
Emissions a l'aire	3,50E-04	3,38%
Aplicació del digestat	5,55E-04	5,36%
Transport	8,95E-06	0,09%
Energia evitada	-5,78E-05	



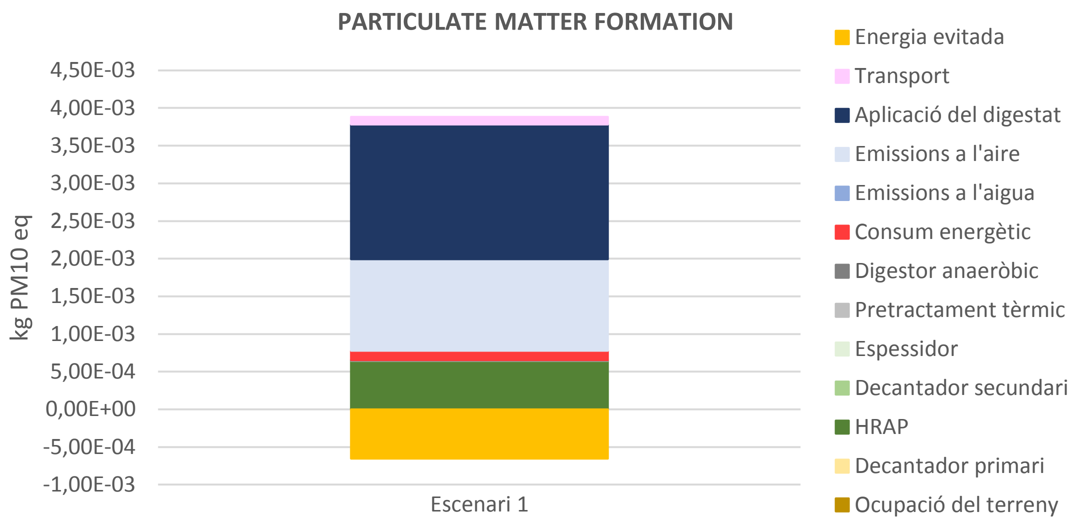
Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**8,64E-01**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	4,16E-04	0,04%
HRAP	9,82E-02	10,29%
Decantador secundari	4,50E-04	0,05%
Espessidor	2,91E-05	0,00%
Pretractament tèrmic	4,53E-05	0,00%
Digestor anaeròbic	1,60E-03	0,17%
Consum energètic	1,41E-02	1,48%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	8,22E-01	86,08%
Transport	1,80E-02	1,88%
Energia evitada	-9,06E-02	



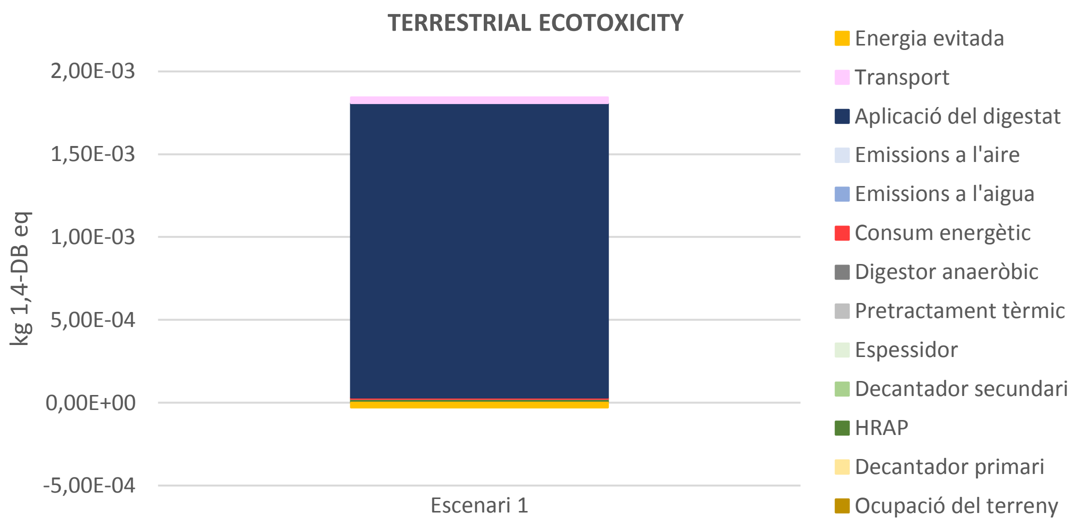
Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**1,41E-04**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	4,19E-06	0,29%
HRAP	9,83E-04	67,80%
Decantador secundari	4,53E-06	0,31%
Espessidor	2,93E-07	0,02%
Pretractament tèrmic	4,56E-07	0,03%
Digestor anaeròbic	1,61E-05	1,11%
Consum energètic	1,98E-04	13,63%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	-3,54E-04	
Transport	2,44E-04	16,80%
Energia evitada	-9,55E-04	



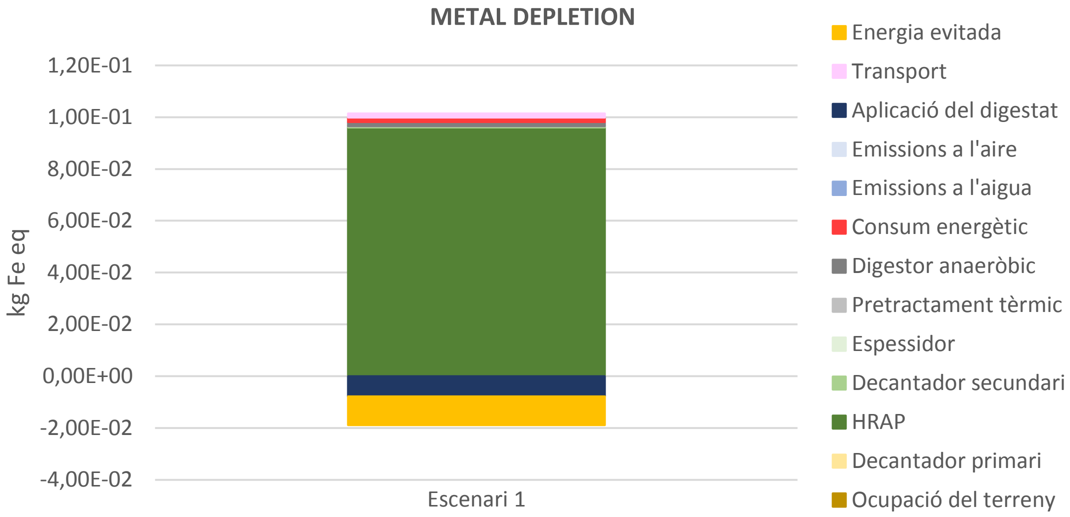
Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**3,23E-03**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	2,72E-06	0,07%
HRAP	6,38E-04	16,44%
Decantador secundari	2,94E-06	0,08%
Espessidor	1,90E-07	0,00%
Pretractament tèrmic	2,96E-07	0,01%
Digestor anaeròbic	1,05E-05	0,27%
Consum energètic	1,22E-04	3,13%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	1,22E-03	31,33%
Aplicació del digestat	1,79E-03	45,98%
Transport	1,04E-04	2,68%
Energia evitada	-6,53E-04	



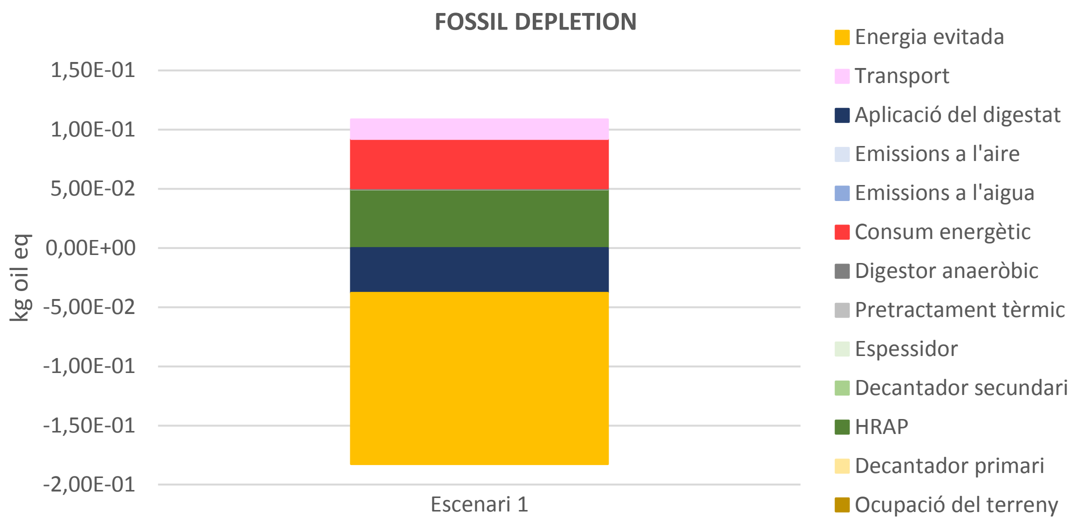
Impact category	**Terrestrial Ecotoxicity**	
Unit	**kg 1,4-DB eq**	
Total	**1,81E-03**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	1,02E-07	0,01%
HRAP	2,40E-05	1,30%
Decantador secundari	1,11E-07	0,01%
Espessidor	7,15E-09	0,00%
Pretractament tèrmic	1,11E-08	0,00%
Digestor anaeròbic	3,93E-07	0,02%
Consum energètic	5,99E-06	0,33%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	1,78E-03	96,51%
Transport	3,36E-05	1,83%
Energia evitada	-2,76E-05	



Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**8,25E-02**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	4,08E-04	0,40%
HRAP	9,56E-02	94,27%
Decantador secundari	4,41E-04	0,43%
Espessidor	2,85E-05	0,03%
Pretractament tèrmic	4,44E-05	0,04%
Digestor anaeròbic	1,57E-03	1,55%
Consum energètic	1,72E-03	1,70%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	-7,84E-03	
Transport	1,60E-03	1,57%
Energia evitada	-1,10E-02	



Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**-7,41E-02**	%
Ocupació del terreny	0,00E+00	0,00%
Decantador primari	2,10E-04	0,19%
HRAP	4,93E-02	45,38%
Decantador secundari	2,27E-04	0,21%
Espessidor	1,47E-05	0,01%
Pretractament tèrmic	2,28E-05	0,02%
Digestor anaeròbic	8,07E-04	0,74%
Consum energètic	4,16E-02	38,28%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del digestat	-3,79E-02	
Transport	1,65E-02	15,16%
Energia evitada	-1,45E-01	



1.1.1. Ocupació del terreny

Impact category	**Climate Change**
Unit	**kg CO_2 eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	**Ozone Depletion**
Unit	**kg CFC-11 eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	**Terrestrial Acidification**
Unit	**kg SO_2 eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	**Freshwater Eutrophication**
Unit	**kg P eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	**Marine Eutrophication**
Unit	**kg N eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	**Human Toxicity**
Unit	**kg 1,4-DB eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	**Photochemical Oxidant Formation**
Unit	**kg NMVOC**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**0,00E+00**
Land occupation	0,00E+00

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**0,00E+00**
Land occupation	0,00E+00

1.1.2. Decantador primari

Impact category	Climate Change	
Unit	**kg CO_2 eq**	
Total	**1,28E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,24E-04	33,17%
Concrete, normal {GLO}| market for | Alloc Def, S	8,53E-04	66,83%

Impact category	Ozone Depletion	
Unit	**kg CFC-11 eq**	
Total	**6,92E-11**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,41E-11	34,85%
Concrete, normal {GLO}| market for | Alloc Def, S	4,51E-11	65,15%

Impact category	Terrestrial Acidification	
Unit	**kg SO_2 eq**	
Total	**3,93E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,72E-06	43,72%
Concrete, normal {GLO}| market for | Alloc Def, S	2,21E-06	56,28%

Impact category	Freshwater Eutrophication	
Unit	**kg P eq**	
Total	**3,50E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,45E-07	70,05%
Concrete, normal {GLO}| market for | Alloc Def, S	1,05E-07	29,95%

Impact category	Marine Eutrophication	
Unit	**kg N eq**	
Total	**1,79E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	7,53E-08	42,11%
Concrete, normal {GLO}| market for | Alloc Def, S	1,03E-07	57,89%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**4,16E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,87E-04	68,97%
Concrete, normal {GLO}| market for | Alloc Def, S	1,29E-04	31,03%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**4,19E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,90E-06	45,27%
Concrete, normal {GLO}| market for | Alloc Def, S	2,29E-06	54,73%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**2,72E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,63E-06	59,96%
Concrete, normal {GLO}| market for | Alloc Def, S	1,09E-06	40,04%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**1,02E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,96E-08	38,71%
Concrete, normal {GLO}| market for | Alloc Def, S	6,27E-08	61,29%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**4,08E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,90E-04	95,66%
Concrete, normal {GLO}| market for | Alloc Def, S	1,77E-05	4,34%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**2,10E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	9,48E-05	45,15%
Concrete, normal {GLO}| market for | Alloc Def, S	1,15E-04	54,85%

1.1.3. HRAP

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**2,99E-01**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	9,88E-02	33,05%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	2,03E-04	0,07%
Glass fibre {GLO}| market for | Alloc Def, S	6,36E-04	0,21%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	2,06E-04	0,07%
Concrete, normal {GLO}| market for | Alloc Def, S	1,99E-01	66,60%

CONCRETE	1,99E-01	66,60%
GLASS FIBRE	6,36E-04	0,21%
STEEL	9,92E-02	33,19%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**1,62E-08**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	5,63E-09	34,69%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,21E-11	0,07%
Glass fibre {GLO}| market for | Alloc Def, S	4,97E-11	0,31%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1,22E-11	0,08%
Concrete, normal {GLO}| market for | Alloc Def, S	1,05E-08	64,86%

CONCRETE	1,05E-08	64,86%
GLASS FIBRE	4,97E-11	0,31%
STEEL	5,65E-09	34,84%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**9,25E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,02E-04	43,43%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	8,99E-07	0,10%
Glass fibre {GLO}| market for | Alloc Def, S	4,24E-06	0,46%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	9,71E-07	0,11%
Concrete, normal {GLO}| market for | Alloc Def, S	5,17E-04	55,91%

CONCRETE	5,17E-04	55,91%
GLASS FIBRE	4,24E-06	0,46%
STEEL	4,03E-04	43,63%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**8,22E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	5,72E-05	69,59%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,84E-07	0,22%
Glass fibre {GLO}| market for | Alloc Def, S	2,31E-07	0,28%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1,17E-07	0,14%
Concrete, normal {GLO}| market for | Alloc Def, S	2,45E-05	29,76%

CONCRETE	2,45E-05	29,76%
GLASS FIBRE	2,31E-07	0,28%
STEEL	5,75E-05	69,96%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**4,20E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,76E-05	41,84%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	4,39E-08	0,10%
Glass fibre {GLO}| market for | Alloc Def, S	1,81E-07	0,43%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	4,31E-08	0,10%
Concrete, normal {GLO}| market for | Alloc Def, S	2,42E-05	57,52%

CONCRETE	2,42E-05	57,52%
GLASS FIBRE	1,81E-07	0,43%
STEEL	1,77E-05	42,04%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**9,82E-02**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	6,70E-02	68,23%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	2,94E-04	0,30%
Glass fibre {GLO}| market for | Alloc Def, S	6,31E-04	0,64%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1,23E-04	0,13%
Concrete, normal {GLO}| market for | Alloc Def, S	3,02E-02	30,70%

CONCRETE	3,02E-02	30,70%
GLASS FIBRE	6,31E-04	0,64%
STEEL	6,74E-02	68,66%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**9,83E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,43E-04	45,06%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	8,88E-07	0,09%
Glass fibre {GLO}| market for | Alloc Def, S	3,02E-06	0,31%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	6,11E-07	0,06%
Concrete, normal {GLO}| market for | Alloc Def, S	5,36E-04	54,48%

CONCRETE	5,36E-04	54,48%
GLASS FIBRE	3,02E-06	0,31%
STEEL	4,44E-04	45,21%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**6,38E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,81E-04	59,64%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	8,50E-07	0,13%
Glass fibre {GLO}| market for | Alloc Def, S	1,95E-06	0,31%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	6,10E-07	0,10%
Concrete, normal {GLO}| market for | Alloc Def, S	2,54E-04	39,83%

CONCRETE	2,54E-04	39,83%
GLASS FIBRE	1,95E-06	0,31%
STEEL	3,82E-04	59,87%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**2,40E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	9,25E-06	38,49%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	3,11E-08	0,13%
Glass fibre {GLO}| market for | Alloc Def, S	9,09E-08	0,38%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1,65E-08	0,07%
Concrete, normal {GLO}| market for | Alloc Def, S	1,46E-05	60,94%

CONCRETE	1,46E-05	60,94%
GLASS FIBRE	9,09E-08	0,38%
STEEL	9,29E-06	38,68%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**9,56E-02**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	9,10E-02	95,22%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	3,17E-04	0,33%
Glass fibre {GLO}| market for | Alloc Def, S	5,02E-05	0,05%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	7,55E-05	0,08%
Concrete, normal {GLO}| market for | Alloc Def, S	4,13E-03	4,32%

CONCRETE	4,13E-03	4,32%
GLASS FIBRE	5,02E-05	0,05%
STEEL	9,14E-02	95,63%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**4,93E-02**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,21E-02	44,89%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	4,78E-05	0,10%
Glass fibre {GLO}| market for | Alloc Def, S	1,78E-04	0,36%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	4,94E-05	0,10%
Concrete, normal {GLO}| market for | Alloc Def, S	2,69E-02	54,55%

CONCRETE	2,69E-02	54,55%
GLASS FIBRE	1,78E-04	0,36%
STEEL	2,22E-02	45,09%

1.1.4. Decantador secundari

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**1,38E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,58E-04	33,17%
Concrete, normal {GLO}| market for | Alloc Def, S	9,23E-04	66,83%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**7,48E-11**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,61E-11	34,85%
Concrete, normal {GLO}| market for | Alloc Def, S	4,88E-11	65,15%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**4,26E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,86E-06	43,72%
Concrete, normal {GLO}| market for | Alloc Def, S	2,40E-06	56,28%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**3,79E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,65E-07	70,04%
Concrete, normal {GLO}| market for | Alloc Def, S	1,13E-07	29,96%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**1,93E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	8,14E-08	42,11%
Concrete, normal {GLO}| market for | Alloc Def, S	1,12E-07	57,89%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**4,50E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,11E-04	68,97%
Concrete, normal {GLO}| market for | Alloc Def, S	1,40E-04	31,03%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**4,53E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,05E-06	45,27%
Concrete, normal {GLO}| market for | Alloc Def, S	2,48E-06	54,73%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**2,94E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,76E-06	59,96%
Concrete, normal {GLO}| market for | Alloc Def, S	1,18E-06	40,04%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**1,11E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,28E-08	38,71%
Concrete, normal {GLO}| market for | Alloc Def, S	6,78E-08	61,29%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**4,41E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,22E-04	95,66%
Concrete, normal {GLO}| market for | Alloc Def, S	1,91E-05	4,34%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**2,27E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,03E-04	45,15%
Concrete, normal {GLO}| market for | Alloc Def, S	1,25E-04	54,85%

1.1.5. Espessidor

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**8,92E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,96E-05	33,17%
Concrete, normal {GLO}| market for | Alloc Def, S	5,96E-05	66,83%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**4,83E-12**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,68E-12	34,84%
Concrete, normal {GLO}| market for | Alloc Def, S	3,15E-12	65,16%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**2,75E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,20E-07	43,71%
Concrete, normal {GLO}| market for | Alloc Def, S	1,55E-07	56,29%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**2,45E-08**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,71E-08	70,04%
Concrete, normal {GLO}| market for | Alloc Def, S	7,33E-09	29,96%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**1,25E-08**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	5,26E-09	42,11%
Concrete, normal {GLO}| market for | Alloc Def, S	7,23E-09	57,89%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**2,91E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,01E-05	68,97%
Concrete, normal {GLO}| market for | Alloc Def, S	9,03E-06	31,03%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**2,93E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,33E-07	45,26%
Concrete, normal {GLO}| market for | Alloc Def, S	1,60E-07	54,74%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**1,90E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,14E-07	59,96%
Concrete, normal {GLO}| market for | Alloc Def, S	7,61E-08	40,04%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**7,15E-09**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,77E-09	38,71%
Concrete, normal {GLO}| market for | Alloc Def, S	4,38E-09	61,29%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**2,85E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,73E-05	95,66%
Concrete, normal {GLO}| market for | Alloc Def, S	1,24E-06	4,34%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**1,47E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	6,62E-06	45,14%
Concrete, normal {GLO}| market for | Alloc Def, S	8,05E-06	54,86%

1.1.6. Pretractament tèrmic

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**1,39E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,61E-05	33,17%
Concrete, normal {GLO}| market for | Alloc Def, S	9,28E-05	66,83%

Impact category	Ozone Depletion	
Unit	**kg CFC-11 eq**	
Total	**7,53E-12**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,62E-12	34,85%
Concrete, normal {GLO}| market for | Alloc Def, S	4,90E-12	65,15%

Impact category	Terrestrial Acidification	
Unit	**kg SO_2 eq**	
Total	**4,28E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,87E-07	43,72%
Concrete, normal {GLO}| market for | Alloc Def, S	2,41E-07	56,28%

Impact category	Freshwater Eutrophication	
Unit	**kg P eq**	
Total	**3,81E-08**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,67E-08	70,04%
Concrete, normal {GLO}| market for | Alloc Def, S	1,14E-08	29,96%

Impact category	Marine Eutrophication	
Unit	**kg N eq**	
Total	**1,94E-08**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	8,19E-09	42,11%
Concrete, normal {GLO}| market for | Alloc Def, S	1,13E-08	57,89%

Impact category	Human Toxicity	
Unit	**kg 1,4-DB eq**	
Total	**4,53E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,12E-05	68,97%
Concrete, normal {GLO}| market for | Alloc Def, S	1,41E-05	31,03%

Impact category	Photochemical Oxidant Formation	
Unit	**kg NMVOC**	
Total	**4,56E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,06E-07	45,27%
Concrete, normal {GLO}| market for | Alloc Def, S	2,50E-07	54,73%

Impact category	Particulate Matter Formation	
Unit	**kg PM10 eq**	
Total	**2,96E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,77E-07	59,96%
Concrete, normal {GLO}| market for | Alloc Def, S	1,19E-07	40,04%

Impact category	Terrestrial Ecotoxicity	
Unit	**kg 1,4-DB eq**	
Total	**1,11E-08**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,31E-09	38,71%
Concrete, normal {GLO}| market for | Alloc Def, S	6,82E-09	61,29%

Impact category	Ionising Radiation	
Unit	**kBq U235 eq**	
Total	**5,74E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,25E-06	39,15%
Concrete, normal {GLO}| market for | Alloc Def, S	3,49E-06	60,85%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**4,44E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,24E-05	95,66%
Concrete, normal {GLO}| market for | Alloc Def, S	1,93E-06	4,34%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**2,28E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,03E-05	45,15%
Concrete, normal {GLO}| market for | Alloc Def, S	1,25E-05	54,85%

1.1.7. Digestor anaeròbic

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**4,91E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,63E-03	33,17%
Concrete, normal {GLO}| market for | Alloc Def, S	3,28E-03	66,83%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**2,66E-10**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	9,27E-11	34,85%
Concrete, normal {GLO}| market for | Alloc Def, S	1,73E-10	65,15%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**1,51E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	6,61E-06	43,72%
Concrete, normal {GLO}| market for | Alloc Def, S	8,51E-06	56,28%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**1,35E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	9,43E-07	70,05%
Concrete, normal {GLO}| market for | Alloc Def, S	4,03E-07	29,95%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**6,87E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,89E-07	42,11%
Concrete, normal {GLO}| market for | Alloc Def, S	3,98E-07	57,89%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**1,60E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,10E-03	68,97%
Concrete, normal {GLO}| market for | Alloc Def, S	4,97E-04	31,03%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**1,61E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	7,29E-06	45,27%
Concrete, normal {GLO}| market for | Alloc Def, S	8,82E-06	54,73%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**1,05E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	6,27E-06	59,96%
Concrete, normal {GLO}| market for | Alloc Def, S	4,19E-06	40,04%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**3,93E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,52E-07	38,71%
Concrete, normal {GLO}| market for | Alloc Def, S	2,41E-07	61,29%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**1,57E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,50E-03	95,66%
Concrete, normal {GLO}| market for | Alloc Def, S	6,80E-05	4,34%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**8,07E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,64E-04	45,15%
Concrete, normal {GLO}| market for | Alloc Def, S	4,43E-04	54,85%

1.1.8. Consum energètic (operació)

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**1,26E-01**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,98E-03	1,57%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,08E-03	4,03%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,07E-03	0,85%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,31E-05	0,04%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	9,92E-02	78,69%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,87E-02	14,82%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**1,13E-08**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,66E-10	2,36%
Electricity, medium voltage {ES}| market for | Alloc Def, S	6,82E-10	6,06%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,44E-10	1,28%
Electricity, medium voltage {ES}| market for | Alloc Def, S	7,14E-12	0,06%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	7,65E-09	67,93%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,51E-09	22,30%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**4,17E-04**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,21E-05	2,91%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,11E-05	7,47%
Electricity, medium voltage {ES}| market for | Alloc Def, S	6,59E-06	1,58%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,26E-07	0,08%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	2,52E-04	60,45%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,15E-04	27,50%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**1,24E-05**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,56E-07	4,49%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,43E-06	11,51%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,02E-07	2,44%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,49E-08	0,12%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	4,84E-06	39,06%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,25E-06	42,38%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**8,88E-06**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,04E-07	4,55%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,04E-06	11,66%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,19E-07	2,47%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,08E-08	0,12%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	3,40E-06	38,26%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,81E-06	42,94%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**1,41E-02**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,47E-04	3,16%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,15E-03	8,09%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,43E-04	1,71%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,20E-05	0,08%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	8,09E-03	57,15%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,22E-03	29,80%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**1,98E-04**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	6,40E-06	3,24%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,64E-05	8,30%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,47E-06	1,76%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,72E-07	0,09%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	1,11E-04	56,04%
Electricity, medium voltage {ES}| market for | Alloc Def, S	6,04E-05	30,57%

Impact category	Particulate Matter Formation	
Unit	**kg PM10 eq**	
Total	**1,22E-04**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,27E-06	3,51%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,09E-05	8,99%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,32E-06	1,90%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,15E-07	0,09%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	6,38E-05	52,42%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,03E-05	33,08%

Impact category	Terrestrial Ecotoxicity	
Unit	**kg 1,4-DB eq**	
Total	**5,99E-06**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,05E-07	1,76%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,70E-07	4,50%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,71E-08	0,95%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,82E-09	0,05%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	4,56E-06	76,16%
Electricity, medium voltage {ES}| market for | Alloc Def, S	9,93E-07	16,58%

Impact category	Metal Depletion	
Unit	**kg Fe eq**	
Total	**1,72E-03**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,41E-05	2,56%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,13E-04	6,57%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,40E-05	1,39%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,18E-06	0,07%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	1,12E-03	65,23%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,17E-04	24,18%

Impact category	Fossil Depletion	
Unit	**kg oil eq**	
Total	**4,16E-02**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,53E-04	1,33%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,42E-03	3,41%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,01E-04	0,72%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,49E-05	0,04%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	3,41E-02	81,93%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,22E-03	12,56%

1.1.9. Emissions a l'aigua (efluent)

Impact category	Climate Change	
Unit	**kg CO_2 eq**	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**3,69E-03**	%
Emission to water COD	0,00E+00	0,00%
Emission to water TSS	0,00E+00	0,00%
Emission to water N	0,00E+00	0,00%
Emission to water P	3,69E-03	100,00%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**9,37E-03**	%
Emission to water COD	0,00E+00	0,00%
Emission to water TSS	0,00E+00	0,00%
Emission to water N	9,37E-03	100,00%
Emission to water P	0,00E+00	0,00%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Terrestrial Ecotoxicity	
Unit	**kg 1,4-DB eq**	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Metal Depletion	
Unit	**kg Fe eq**	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Fossil Depletion	
Unit	**kg oil eq**	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

1.1.10. Emissions a l'aire (HRAP)

Impact category	Climate change
Unit	**kg CO_2 eq**
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Ozone depletion
Unit	**kg CFC-11 eq**
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Terrestrial Acidification
Unit	**kg SO_2 eq**
Total	**9,32E-03**
Emission to air NH_3	9,32E-03

Impact category	Freshwater Eutrophication
Unit	**kg P eq**
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Marine Eutrophication
Unit	**kg N eq**
Total	**3,50E-04**
Emission to air NH_3	3,50E-04

Impact category	Human Toxicity
Unit	**kg 1,4-DB eq**
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Photochemical Oxidant Formation
Unit	kg NMVOC
Total	0,00E+00
Emission to air NH_3	0,00E+00

Impact category	Particulate Matter Formation
Unit	kg PM10 eq
Total	1,22E-03
Emission to air NH_3	1,22E-03

Impact category	Terrestrial Ecotoxicity
Unit	kg 1,4-DB eq
Total	0,00E+00
Emission to air NH_3	0,00E+00

Impact category	Metal Depletion
Unit	kg Fe eq
Total	0,00E+00
Emission to air NH_3	0,00E+00

Impact category	Fossil Depletion
Unit	kg oil eq
Total	0,00E+00
Emission to air NH_3	0,00E+00

1.1.11. Aplicació del digestat

Impact category	Climate Change
Unit	kg CO_2 eq
Total	-9,64E-02
Digestate	-9,64E-02

Impact category	Ozone Depletion
Unit	kg CFC-11 eq
Total	-1,91E-08
Digestate	-1,91E-08

Impact category	Terrestrial Acidification
Unit	kg SO_2 eq
Total	1,50E-02
Digestate	1,50E-02

Impact category	Freshwater Eutrophication
Unit	kg P eq
Total	-1,92E-05
Digestate	-1,92E-05

Impact category	Marine Eutrophication
Unit	kg N eq
Total	5,55E-04
Digestate	5,55E-04

Impact category	Human Toxicity
Unit	kg 1,4-DB eq
Total	8,22E-01
Digestate	8,22E-01

Impact category	Photochemical Oxidant Formation
Unit	**kg NMVOC**
Total	**-3,54E-04**
Digestate	-3,54E-04

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**1,79E-03**
Digestate	1,79E-03

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**1,78E-03**
Digestate	1,78E-03

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**-7,84E-03**
Digestate	-7,84E-03

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**-3,79E-02**
Digestate	-3,79E-02

1.1.12. Transport del digestat

Impact category	Climate Change
Unit	**kg CO_2 eq**
Total	**4,55E-02**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	4,55E-02

Impact category	Ozone Depletion
Unit	**kg CFC-11 eq**
Total	**8,43E-09**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	8,43E-09

Impact category	Terrestrial Acidification
Unit	**kg SO_2 eq**
Total	**1,80E-04**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,80E-04

Impact category	Freshwater Eutrophication
Unit	**kg P eq**
Total	**3,67E-06**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	3,67E-06

Impact category	Marine Eutrophication
Unit	**kg N eq**
Total	**8,95E-06**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	8,95E-06

Impact category	Human Toxicity
Unit	**kg 1,4-DB eq**
Total	**1,80E-02**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,80E-02

Impact category	Photochemical Oxidant Formation
Unit	**kg NMVOC**
Total	**2,44E-04**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	2,44E-04

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**1,04E-04**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,04E-04

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**3,36E-05**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	3,36E-05

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**1,60E-03**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,60E-03

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**1,65E-02**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,65E-02

1.1.13. Energia evitada (cogeneració biogàs)

Impact category	Climate Change
Unit	**kg CO_2 eq**
Total	**-4,63E-01**
Biogas coproduct	-4,63E-01

Impact category	Ozone Depletion
Unit	**kg CFC-11 eq**
Total	**-5,12E-08**
Biogas coproduct	-5,12E-08

Impact category	Terrestrial Acidification
Unit	**kg SO_2 eq**
Total	**-1,97E-03**
Biogas coproduct	-1,97E-03

Impact category	Freshwater Eutrophication
Unit	**kg P eq**
Total	**-8,84E-05**
Biogas coproduct	-8,84E-05

Impact category	Marine Eutrophication
Unit	**kg N eq**
Total	**-5,78E-05**
Biogas coproduct	-5,78E-05

Impact category	Human Toxicity
Unit	**kg 1,4-DB eq**
Total	**-9,06E-02**
Biogas coproduct	-9,06E-02

Impact category	Photochemical Oxidant Formation
Unit	**kg NMVOC**
Total	**-9,55E-04**
Biogas coproduct	-9,55E-04

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**-6,53E-04**
Biogas coproduct	-6,53E-04

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**-2,76E-05**
Biogas coproduct	-2,76E-05

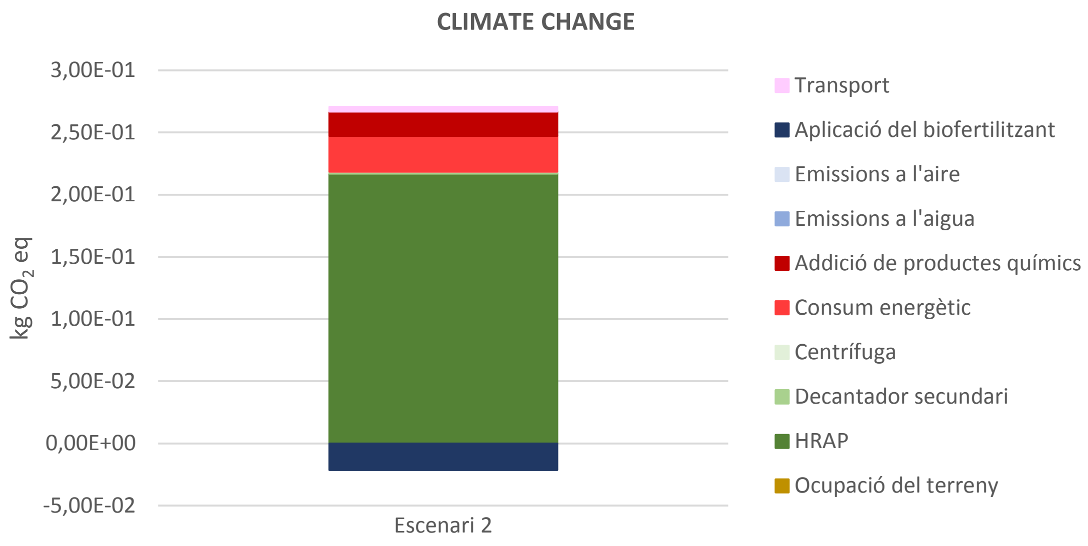
Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**-1,10E-02**
Biogas coproduct	-1,10E-02

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**-1,45E-01**
Biogas coproduct	-1,45E-01

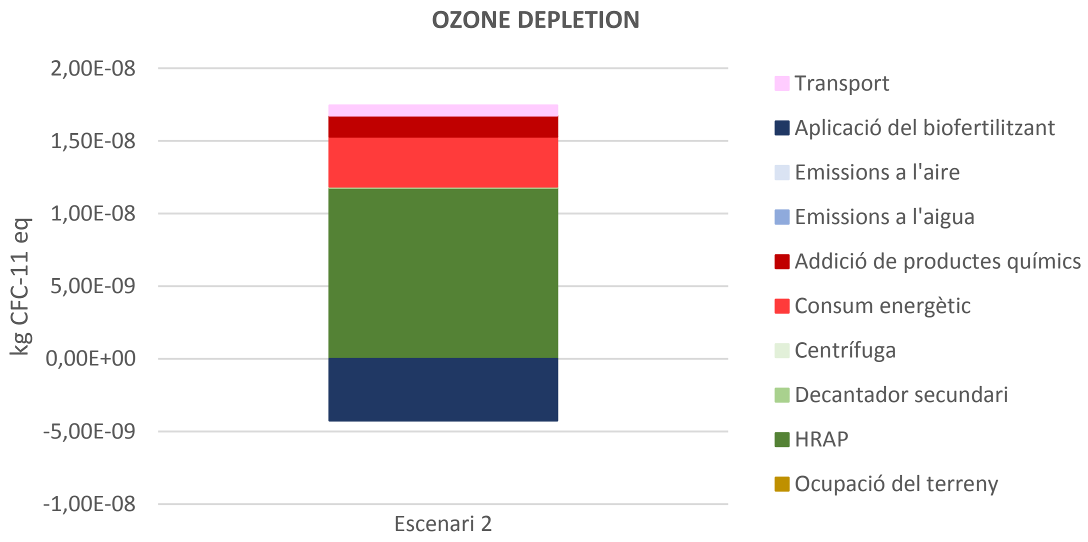
1.2. ESCENARI 2

1.2.0. Base

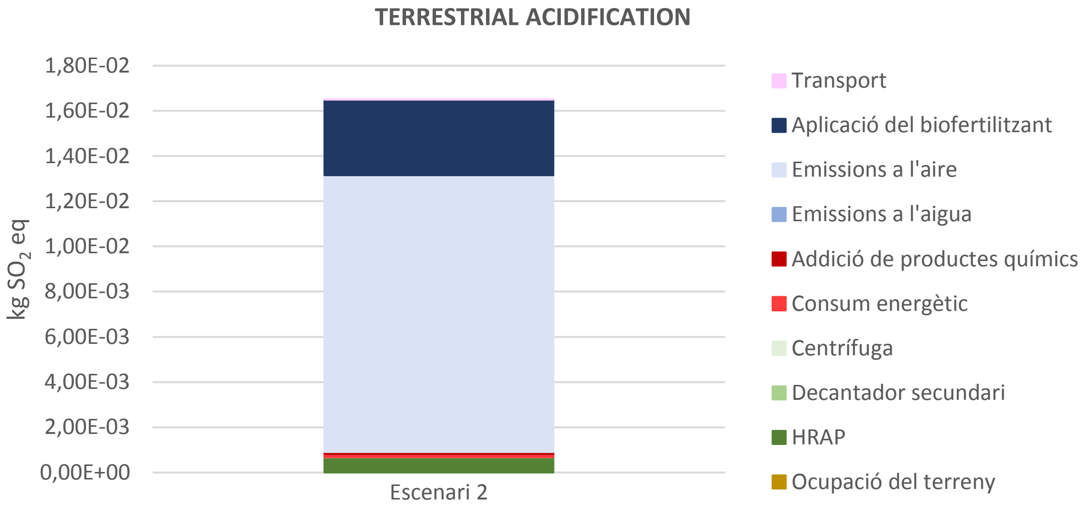
Impact category	Climate Change	
Unit	**kg CO_2 eq**	
Total	**2,49E-01**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	2,17E-01	80,17%
Decantador secundari	1,38E-03	0,51%
Centrífuga	1,48E-04	0,05%
Consum energètic	2,86E-02	10,57%
Addició de productes químics	1,97E-02	7,28%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	-2,15E-02	
Transport	3,84E-03	1,42%



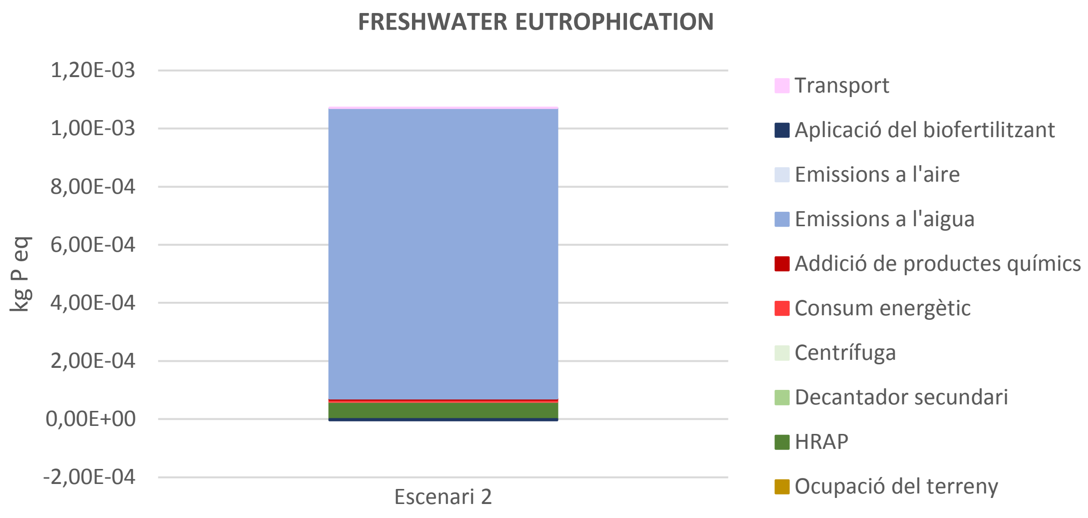
Impact category	Ozone Depletion	
Unit	**kg CFC-11 eq**	
Total	**1,32E-08**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	1,18E-08	67,45%
Decantador secundari	7,48E-11	0,43%
Centrífuga	8,75E-12	0,05%
Consum energètic	3,45E-09	19,75%
Addició de productes químics	1,44E-09	8,24%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	-4,25E-09	
Transport	7,11E-10	4,08%



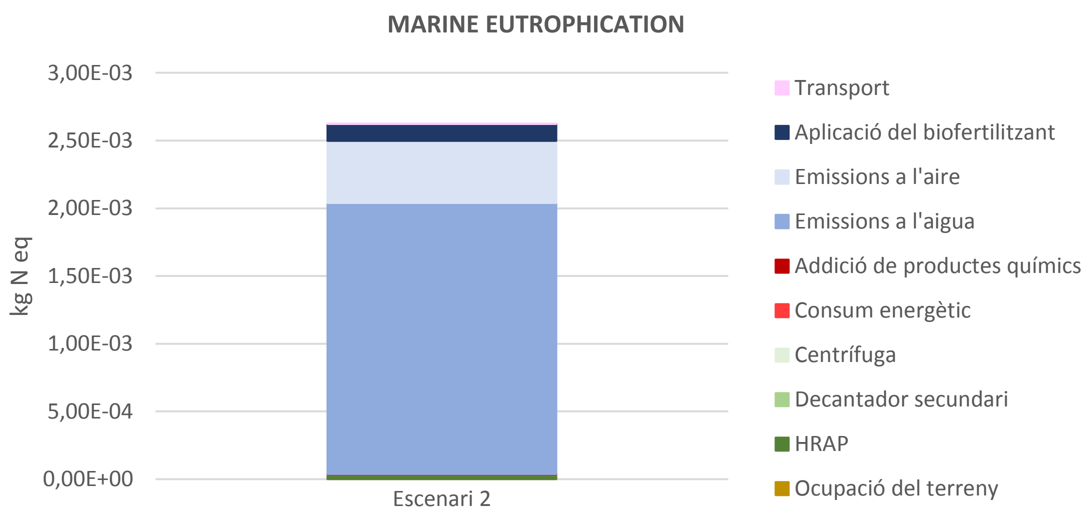
Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**1,65E-02**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	6,70E-04	4,06%
Decantador secundari	4,26E-06	0,03%
Centrífuga	6,74E-07	0,00%
Consum energètic	1,51E-04	0,91%
Addició de productes químics	7,84E-05	0,47%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	1,22E-02	74,19%
Aplicació del biofertilitzant	3,34E-03	20,24%
Transport	1,52E-05	0,09%



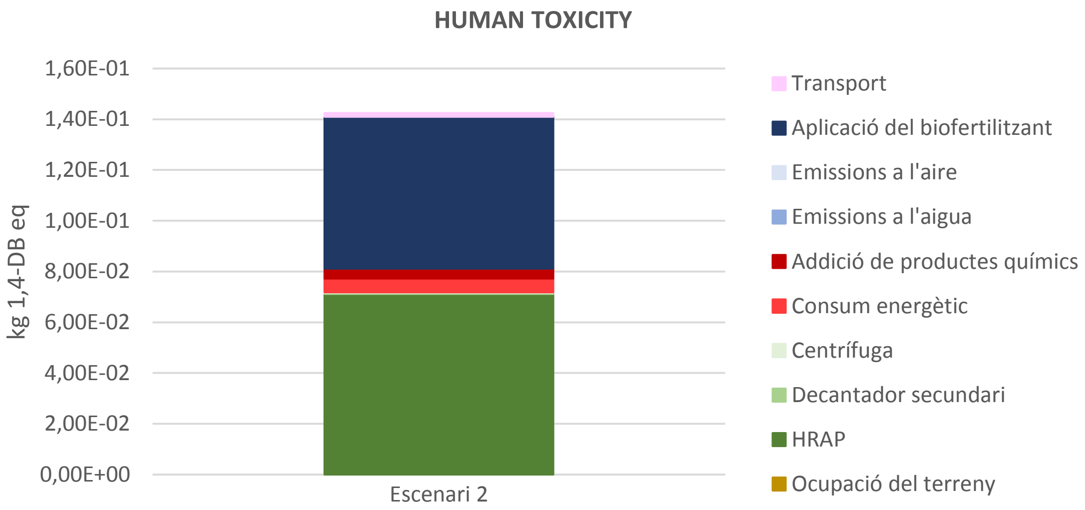
Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**1,07E-03**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	5,96E-05	5,57%
Decantador secundari	3,79E-07	0,04%
Centrífuga	1,08E-07	0,01%
Consum energètic	6,43E-06	0,60%
Addició de productes químics	3,96E-06	0,37%
Emissions a l'aigua	1,00E-03	93,39%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	-4,28E-06	
Transport	3,09E-07	0,03%



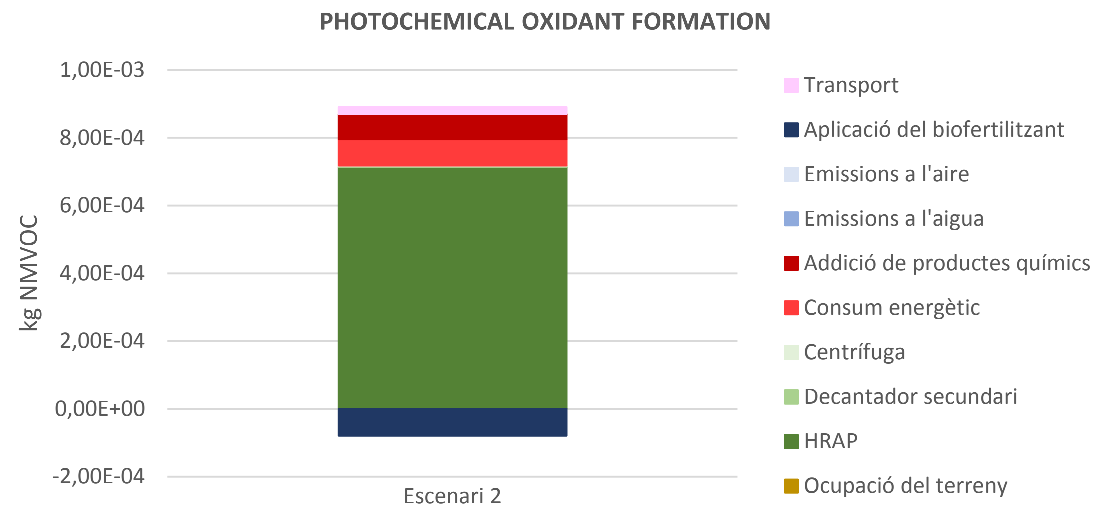
Impact category	Marine Eutrophication	
Unit	**kg N eq**	
Total	**2,62E-03**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	3,04E-05	1,16%
Decantador secundari	1,93E-07	0,01%
Centrífuga	3,13E-08	0,00%
Consum energètic	4,66E-06	0,18%
Addició de productes químics	2,67E-06	0,10%
Emissions a l'aigua	2,00E-03	76,27%
Emissions a l'aire	4,60E-04	17,54%
Aplicació del biofertilitzant	1,24E-04	4,72%
Transport	7,55E-07	0,03%



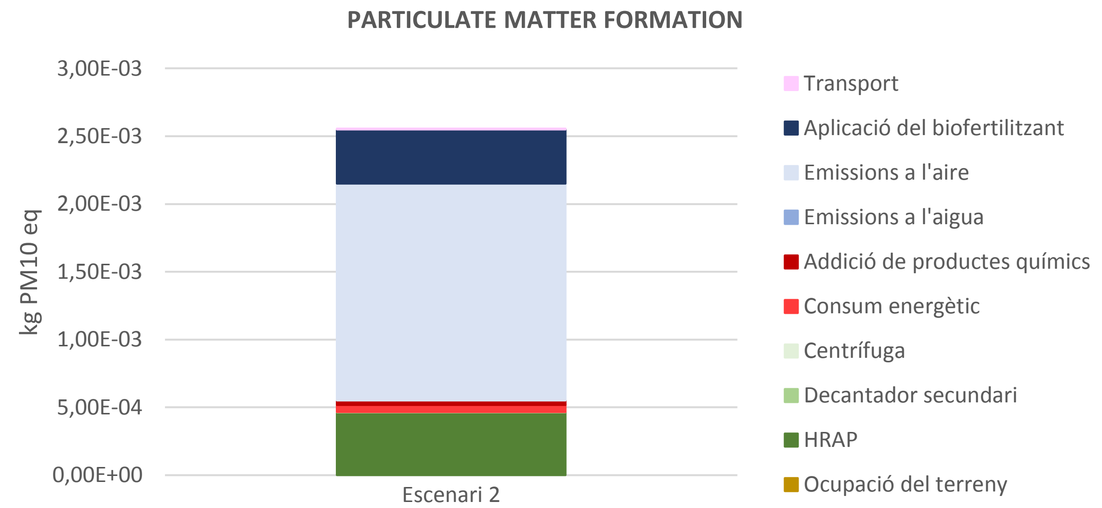
Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**1,42E-01**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	7,11E-02	49,94%
Decantador secundari	4,50E-04	0,32%
Centrífuga	1,51E-04	0,11%
Consum energètic	5,46E-03	3,83%
Addició de productes químics	3,96E-03	2,78%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	5,98E-02	41,96%
Transport	1,51E-03	1,06%



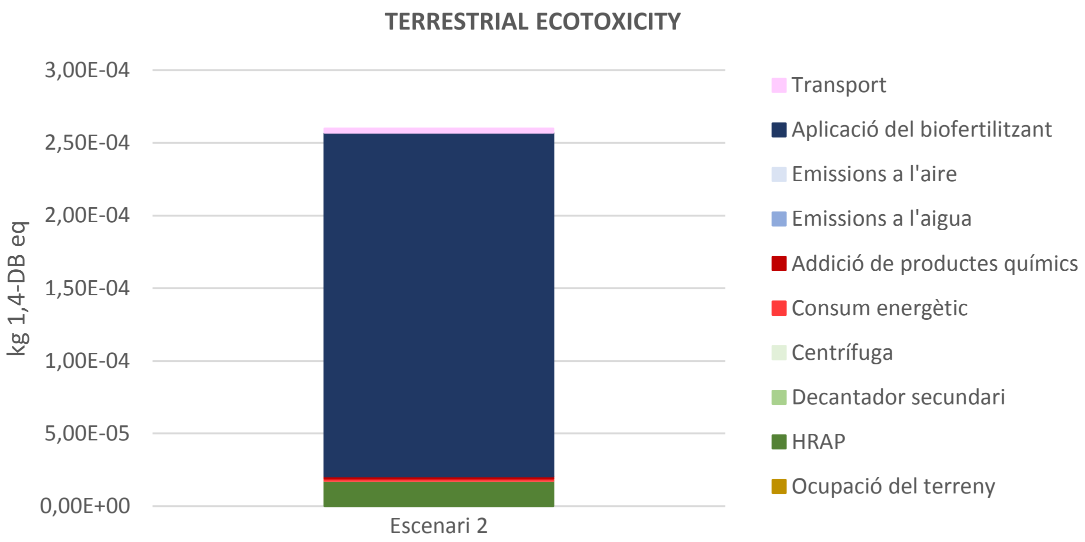
Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**8,12E-04**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	7,13E-04	80,01%
Decantador secundari	4,53E-06	0,51%
Centrífuga	5,40E-07	0,06%
Consum energètic	7,78E-05	8,73%
Addició de productes químics	7,47E-05	8,38%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	-7,90E-05	
Transport	2,05E-05	2,30%



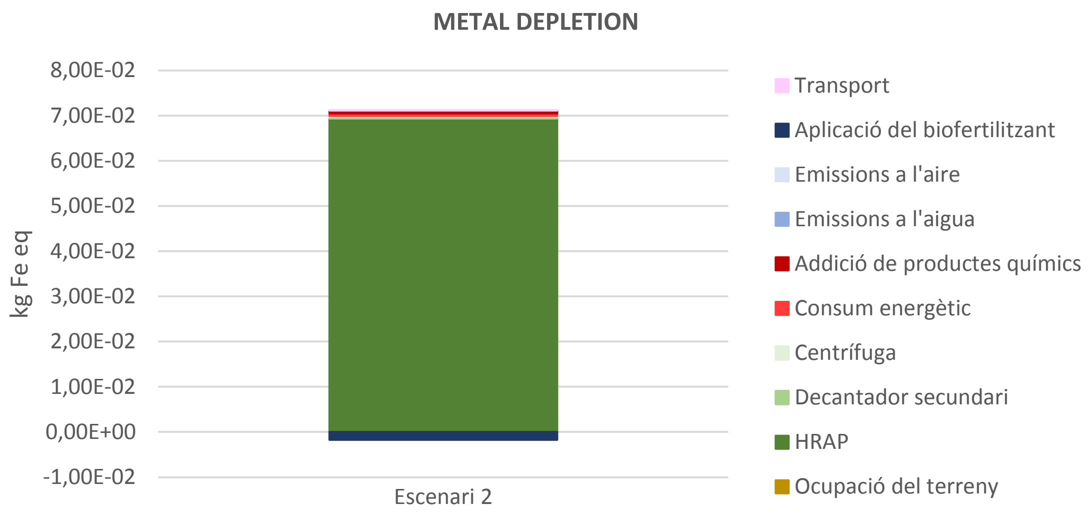
Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**2,56E-03**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	4,63E-04	18,11%
Decantador secundari	2,94E-06	0,12%
Centrífuga	5,26E-07	0,02%
Consum energètic	5,12E-05	2,00%
Addició de productes químics	3,27E-05	1,28%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	1,60E-03	62,56%
Aplicació del biofertilitzant	3,98E-04	15,57%
Transport	8,79E-06	0,34%



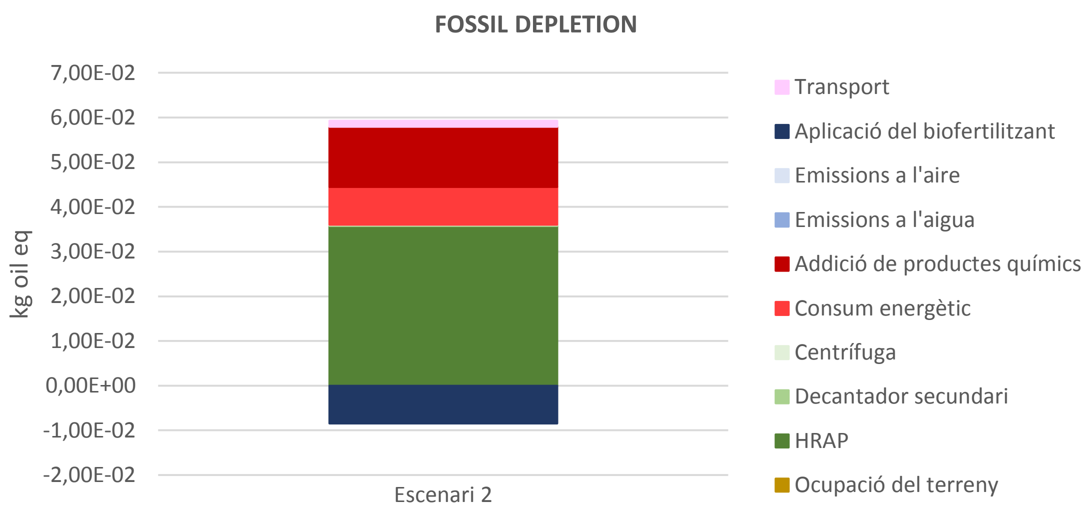
Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**2,60E-04**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	1,74E-05	6,71%
Decantador secundari	1,11E-07	0,04%
Centrífuga	1,71E-08	0,01%
Consum energètic	1,47E-06	0,57%
Addició de productes químics	1,48E-06	0,57%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	2,36E-04	91,02%
Transport	2,84E-06	1,09%



Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**6,95E-02**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	6,94E-02	97,39%
Decantador secundari	4,41E-04	0,62%
Centrífuga	1,41E-04	0,20%
Consum energètic	5,62E-04	0,79%
Addició de productes químics	5,83E-04	0,82%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	-1,75E-03	
Transport	1,35E-04	0,19%



Impact category	Fossil Depletion	
Unit	**kg oil eq**	
Total	**5,08E-02**	%
Ocupació del terreny	0,00E+00	0,00%
HRAP	3,57E-02	60,28%
Decantador secundari	2,27E-04	0,38%
Centrífuga	3,50E-05	0,06%
Consum energètic	8,44E-03	14,24%
Addició de productes químics	1,35E-02	22,70%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Aplicació del biofertilitzant	-8,44E-03	
Transport	1,39E-03	2,34%



1.2.1. Ocupació del terreny

Impact category	Climate Change
Unit	kg CO_2 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Ozone Depletion
Unit	kg CFC-11 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Terrestrial Acidification
Unit	kg SO_2 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Freshwater Eutrophication
Unit	kg P eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Marine Eutrophication
Unit	kg N eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Human Toxicity
Unit	kg 1,4-DB eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Photochemical Oxidant Formation
Unit	kg NMVOC
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Particulate Matter Formation
Unit	kg PM10 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Terrestrial Ecotoxicity
Unit	kg 1,4-DB eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Metal Depletion
Unit	kg Fe eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Fossil Depletion
Unit	kg oil eq
Total	0,00E+00
Land occupation	0,00E+00

1.2.2. HRAP

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**2,17E-01**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	7,18E-02	33,09%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,02E-04	0,05%
Glass fibre {GLO}| market for | Alloc Def, S	3,18E-04	0,15%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1,03E-04	0,05%
Concrete, normal {GLO}| market for | Alloc Def, S	1,45E-01	66,67%

CONCRETE	1,45E-01	66,67%
GLASS FIBRE	3,18E-04	0,15%
STEEL	7,20E-02	33,19%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**1,18E-08**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,09E-09	34,74%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	6,03E-12	0,05%
Glass fibre {GLO}| market for | Alloc Def, S	2,48E-11	0,21%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	6,09E-12	0,05%
Concrete, normal {GLO}| market for | Alloc Def, S	7,64E-09	64,94%

CONCRETE	7,64E-09	64,94%
GLASS FIBRE	2,48E-11	0,21%
STEEL	4,10E-09	34,84%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**6,70E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,92E-04	43,52%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	4,49E-07	0,07%
Glass fibre {GLO}| market for | Alloc Def, S	2,12E-06	0,32%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	4,85E-07	0,07%
Concrete, normal {GLO}| market for | Alloc Def, S	3,76E-04	56,02%

CONCRETE	3,76E-04	56,02%
GLASS FIBRE	2,12E-06	0,32%
STEEL	2,93E-04	43,66%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**5,96E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,16E-05	69,73%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	9,19E-08	0,15%
Glass fibre {GLO}| market for | Alloc Def, S	1,15E-07	0,19%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	5,85E-08	0,10%
Concrete, normal {GLO}| market for | Alloc Def, S	1,78E-05	29,82%

CONCRETE	1,78E-05	29,82%
GLASS FIBRE	1,15E-07	0,19%
STEEL	4,17E-05	69,99%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**3,04E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,28E-05	41,93%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	2,19E-08	0,07%
Glass fibre {GLO}| market for | Alloc Def, S	9,06E-08	0,30%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	2,15E-08	0,07%
Concrete, normal {GLO}| market for | Alloc Def, S	1,75E-05	57,63%

CONCRETE	1,75E-05	57,63%
GLASS FIBRE	9,06E-08	0,30%
STEEL	1,28E-05	42,07%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**7,11E-02**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,87E-02	68,46%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,47E-04	0,21%
Glass fibre {GLO}| market for | Alloc Def, S	3,15E-04	0,44%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	6,16E-05	0,09%
Concrete, normal {GLO}| market for | Alloc Def, S	2,19E-02	30,80%

CONCRETE	2,19E-02	30,80%
GLASS FIBRE	3,15E-04	0,44%
STEEL	4,89E-02	68,76%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**7,13E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,22E-04	45,13%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	4,44E-07	0,06%
Glass fibre {GLO}| market for | Alloc Def, S	1,51E-06	0,21%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	3,05E-07	0,04%
Concrete, normal {GLO}| market for | Alloc Def, S	3,89E-04	54,56%

CONCRETE	3,89E-04	54,56%
GLASS FIBRE	1,51E-06	0,21%
STEEL	3,23E-04	45,23%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**4,63E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,77E-04	59,74%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	4,25E-07	0,09%
Glass fibre {GLO}| market for | Alloc Def, S	9,75E-07	0,21%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	3,05E-07	0,07%
Concrete, normal {GLO}| market for | Alloc Def, S	1,85E-04	39,89%

CONCRETE	1,85E-04	39,89%
GLASS FIBRE	9,75E-07	0,21%
STEEL	2,77E-04	59,90%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	1,74E-05	%
Reinforcing steel {GLO}| market for | Alloc Def, S	6,72E-06	38,56%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,55E-08	0,09%
Glass fibre {GLO}| market for | Alloc Def, S	4,55E-08	0,26%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	8,24E-09	0,05%
Concrete, normal {GLO}| market for | Alloc Def, S	1,06E-05	61,04%

CONCRETE	1,06E-05	61,04%
GLASS FIBRE	4,55E-08	0,26%
STEEL	6,74E-06	38,70%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	6,94E-02	%
Reinforcing steel {GLO}| market for | Alloc Def, S	6,61E-02	95,35%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,58E-04	0,23%
Glass fibre {GLO}| market for | Alloc Def, S	2,51E-05	0,04%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	3,77E-05	0,05%
Concrete, normal {GLO}| market for | Alloc Def, S	3,00E-03	4,33%

CONCRETE	3,00E-03	4,33%
GLASS FIBRE	2,51E-05	0,04%
STEEL	6,63E-02	95,64%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	3,57E-02	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,61E-02	44,98%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	2,39E-05	0,07%
Glass fibre {GLO}| market for | Alloc Def, S	8,90E-05	0,25%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	2,47E-05	0,07%
Concrete, normal {GLO}| market for | Alloc Def, S	1,95E-02	54,64%

CONCRETE	1,95E-02	54,64%
GLASS FIBRE	8,90E-05	0,25%
STEEL	1,61E-02	45,11%

1.2.3. Decantador secundari

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	1,38E-03	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,58E-04	33,17%
Concrete, normal {GLO}| market for | Alloc Def, S	9,23E-04	66,83%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	7,48E-11	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,61E-11	34,85%
Concrete, normal {GLO}| market for | Alloc Def, S	4,88E-11	65,15%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**4,26E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,86E-06	43,72%
Concrete, normal {GLO}| market for | Alloc Def, S	2,40E-06	56,28%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**3,79E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,65E-07	70,04%
Concrete, normal {GLO}| market for | Alloc Def, S	1,13E-07	29,96%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**1,93E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	8,14E-08	42,11%
Concrete, normal {GLO}| market for | Alloc Def, S	1,12E-07	57,89%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**4,50E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,11E-04	68,97%
Concrete, normal {GLO}| market for | Alloc Def, S	1,40E-04	31,03%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**4,53E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,05E-06	45,27%
Concrete, normal {GLO}| market for | Alloc Def, S	2,48E-06	54,73%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**2,94E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,76E-06	59,96%
Concrete, normal {GLO}| market for | Alloc Def, S	1,18E-06	40,04%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**1,11E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,28E-08	38,71%
Concrete, normal {GLO}| market for | Alloc Def, S	6,78E-08	61,29%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**4,41E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	4,22E-04	95,66%
Concrete, normal {GLO}| market for | Alloc Def, S	1,91E-05	4,34%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**2,27E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,03E-04	45,15%
Concrete, normal {GLO}| market for | Alloc Def, S	1,25E-04	54,85%

1.2.4. Centrífuga

Impact category	Climate Change	
Unit	**kg CO_2 eq**	
Total	**1,48E-04**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	7,33E-05	49,69%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	7,43E-05	50,31%

Impact category	Ozone Depletion	
Unit	**kg CFC-11 eq**	
Total	**8,75E-12**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	4,35E-12	49,75%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	4,39E-12	50,25%

Impact category	Terrestrial Acidification	
Unit	**kg SO_2 eq**	
Total	**6,74E-07**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	3,24E-07	48,08%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	3,50E-07	51,92%

Impact category	Freshwater Eutrophication	
Unit	**kg P eq**	
Total	**1,08E-07**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	6,63E-08	61,09%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	4,22E-08	38,91%

Impact category	Marine Eutrophication	
Unit	**kg N eq**	
Total	**3,13E-08**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,58E-08	50,48%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1,55E-08	49,52%

Impact category	Human Toxicity	
Unit	**kg 1,4-DB eq**	
Total	**1,51E-04**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,06E-04	70,48%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	4,44E-05	29,52%

Impact category	Photochemical Oxidant Formation	
Unit	**kg NMVOC**	
Total	**5,40E-07**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	3,20E-07	59,25%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	2,20E-07	40,75%

Impact category	Particulate Matter Formation	
Unit	**kg PM10 eq**	
Total	**5,26E-07**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	3,06E-07	58,21%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	2,20E-07	41,79%

Impact category	Terrestrial Ecotoxicity	
Unit	**kg 1,4-DB eq**	
Total	**1,71E-08**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,12E-08	65,34%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	5,94E-09	34,66%

Impact category	Metal Depletion	
Unit	**kg Fe eq**	
Total	**1,41E-04**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,14E-04	80,75%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	2,72E-05	19,25%

Impact category	Fossil Depletion	
Unit	**kg oil eq**	
Total	**3,50E-05**	%
Steel, low-alloyed, hot rolled {GLO}| market for | Alloc Def, S	1,72E-05	49,20%
Metal working, average for steel product manufacturing {GLO}| market for | Alloc Def, S	1,78E-05	50,80%

1.2.5. Consum energètic (operació)

Impact category	Climate Change	
Unit	**kg CO_2 eq**	
Total	**2,86E-02**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,95E-03	17,32%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,59E-03	9,05%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,17E-03	18,09%
Electricity, medium voltage {ES}| market for | Alloc Def, S	8,97E-03	31,35%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	6,92E-03	24,20%

Impact category	Ozone Depletion	
Unit	**kg CFC-11 eq**	
Total	**3,45E-09**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	6,66E-10	19,31%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,48E-10	10,09%
Electricity, medium voltage {ES}| market for | Alloc Def, S	6,95E-10	20,17%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,20E-09	34,95%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	5,34E-10	15,48%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**1,51E-04**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,04E-05	20,18%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,59E-05	10,54%
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,17E-05	21,08%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,50E-05	36,53%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	1,76E-05	11,67%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**6,43E-06**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,39E-06	21,65%
Electricity, medium voltage {ES}| market for | Alloc Def, S	7,27E-07	11,31%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,45E-06	22,61%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,52E-06	39,18%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	3,37E-07	5,25%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**4,66E-06**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,01E-06	21,69%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,28E-07	11,33%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,06E-06	22,65%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,83E-06	39,25%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	2,37E-07	5,08%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**5,46E-03**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,12E-03	20,49%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,84E-04	10,70%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,17E-03	21,39%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,02E-03	37,08%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	5,64E-04	10,34%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**7,78E-05**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,60E-05	20,58%
Electricity, medium voltage {ES}| market for | Alloc Def, S	8,36E-06	10,75%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,67E-05	21,49%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,90E-05	37,25%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	7,73E-06	9,93%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**5,12E-05**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,07E-05	20,86%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,58E-06	10,90%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,12E-05	21,79%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,93E-05	37,76%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	4,45E-06	8,70%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**1,47E-06**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,63E-07	17,90%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,38E-07	9,35%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,75E-07	18,70%
Electricity, medium voltage {ES}| market for | Alloc Def, S	4,77E-07	32,40%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	3,18E-07	21,64%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**5,62E-04**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,10E-04	19,66%
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,77E-05	10,27%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,15E-04	20,53%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,00E-04	35,58%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	7,84E-05	13,96%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**8,44E-03**	%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,39E-03	16,41%
Electricity, medium voltage {ES}| market for | Alloc Def, S	7,24E-04	8,57%
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,45E-03	17,14%
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,51E-03	29,71%
Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | Alloc Def, S	2,38E-03	28,17%

1.2.6. Addició de productes químics (operació)

Impact category	Climate Change
Unit	kg CO_2 eq
Total	**1,97E-02**
Chemical, organic {GLO}| market for | Alloc Def, S	1,97E-02

Impact category	Ozone Depletion
Unit	kg CFC-11 eq
Total	**1,44E-09**
Chemical, organic {GLO}| market for | Alloc Def, S	1,44E-09

Impact category	Terrestrial Acidification
Unit	kg SO_2 eq
Total	**7,84E-05**
Chemical, organic {GLO}| market for | Alloc Def, S	7,84E-05

Impact category	Freshwater Eutrophication
Unit	**kg P eq**
Total	**3,96E-06**
Chemical, organic {GLO}| market for | Alloc Def, S	3,96E-06

Impact category	Marine Eutrophication
Unit	**kg N eq**
Total	**2,67E-06**
Chemical, organic {GLO}| market for | Alloc Def, S	2,67E-06

Impact category	Human Toxicity
Unit	**kg 1,4-DB eq**
Total	**3,96E-03**
Chemical, organic {GLO}| market for | Alloc Def, S	3,96E-03

Impact category	Photochemical Oxidant Formation
Unit	**kg NMVOC**
Total	**7,47E-05**
Chemical, organic {GLO}| market for | Alloc Def, S	7,47E-05

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**3,27E-05**
Chemical, organic {GLO}| market for | Alloc Def, S	3,27E-05

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**1,48E-06**
Chemical, organic {GLO}| market for | Alloc Def, S	1,48E-06

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**5,83E-04**
Chemical, organic {GLO}| market for | Alloc Def, S	5,83E-04

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**1,35E-02**
Chemical, organic {GLO}| market for | Alloc Def, S	1,35E-02

1.2.7. Emissions a l'aigua (efluent)

Impact category	Climate Change	
Unit	**kg CO_2 eq**	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Ozone Depletion	
Unit	**kg CFC-11 eq**	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**1,00E-03**	%
Emission to water COD	0,00E+00	0,00%
Emission to water TSS	0,00E+00	0,00%
Emission to water N	0,00E+00	0,00%
Emission to water P	1,00E-03	100,00%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**2,00E-03**	%
Emission to water COD	0,00E+00	0,00%
Emission to water TSS	0,00E+00	0,00%
Emission to water N	2,00E-03	100,00%
Emission to water P	0,00E+00	0,00%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

1.2.8. Emissions a l'aire (HRAP)

Impact category	Climate Change
Unit	kg CO_2 eq
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Ozone Depletion
Unit	kg CFC-11 eq
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Terrestrial Acidification
Unit	kg SO_2 eq
Total	**1,22E-02**
Emission to air NH_3	1,22E-02

Impact category	Freshwater Eutrophication
Unit	kg P eq
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Marine Eutrophication
Unit	kg N eq
Total	**4,60E-04**
Emission to air NH_3	4,60E-04

Impact category	Human Toxicity
Unit	kg 1,4-DB eq
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Photochemical Oxidant Formation
Unit	kg NMVOC
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**1,60E-03**
Emission to air NH_3	1,60E-03

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**0,00E+00**
Emission to air NH_3	0,00E+00

1.2.9. Aplicació del biofertilitzant

Impact category	Climate Change
Unit	**kg CO_2 eq**
Total	**-2,15E-02**
Biofertilizer	-2,15E-02

Impact category	Ozone Depletion
Unit	**kg CFC-11 eq**
Total	**-4,25E-09**
Biofertilizer	-4,25E-09

Impact category	Terrestrial Acidification
Unit	**kg SO_2 eq**
Total	**3,34E-03**
Biofertilizer	3,34E-03

Impact category	Freshwater Eutrophication
Unit	**kg P eq**
Total	**-4,28E-06**
Biofertilizer	-4,28E-06

Impact category	Marine Eutrophication
Unit	**kg N eq**
Total	**1,24E-04**
Biofertilizer	1,24E-04

Impact category	Human Toxicity
Unit	**kg 1,4-DB eq**
Total	**5,98E-02**
Biofertilizer	5,98E-02

Impact category	Photochemical Oxidant Formation
Unit	**kg NMVOC**
Total	**-7,90E-05**
Biofertilizer	-7,90E-05

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**3,98E-04**
Biofertilizer	3,98E-04

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**2,36E-04**
Biofertilizer	2,36E-04

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**-1,75E-03**
Biofertilizer	-1,75E-03

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**-8,44E-03**
Biofertilizer	-8,44E-03

1.2.10. Transport del biofertilitzant

Impact category	Climate Change
Unit	**kg CO_2 eq**
Total	**3,84E-03**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	3,84E-03

Impact category	Ozone Depletion
Unit	**kg CFC-11 eq**
Total	**7,11E-10**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	7,11E-10

Impact category	Terrestrial Acidification
Unit	**kg SO_2 eq**
Total	**1,52E-05**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,52E-05

Impact category	Freshwater Eutrophication
Unit	**kg P eq**
Total	**3,09E-07**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	3,09E-07

Impact category	Marine Eutrophication
Unit	**kg N eq**
Total	**7,55E-07**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	7,55E-07

Impact category	Human Toxicity
Unit	kg 1,4-DB eq
Total	**1,51E-03**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,51E-03

Impact category	Photochemical Oxidant Formation
Unit	kg NMVOC
Total	**2,05E-05**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	2,05E-05

Impact category	Particulate Matter Formation
Unit	kg PM10 eq
Total	**8,79E-06**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	8,79E-06

Impact category	Terrestrial Ecotoxicity
Unit	kg 1,4-DB eq
Total	**2,84E-06**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	2,84E-06

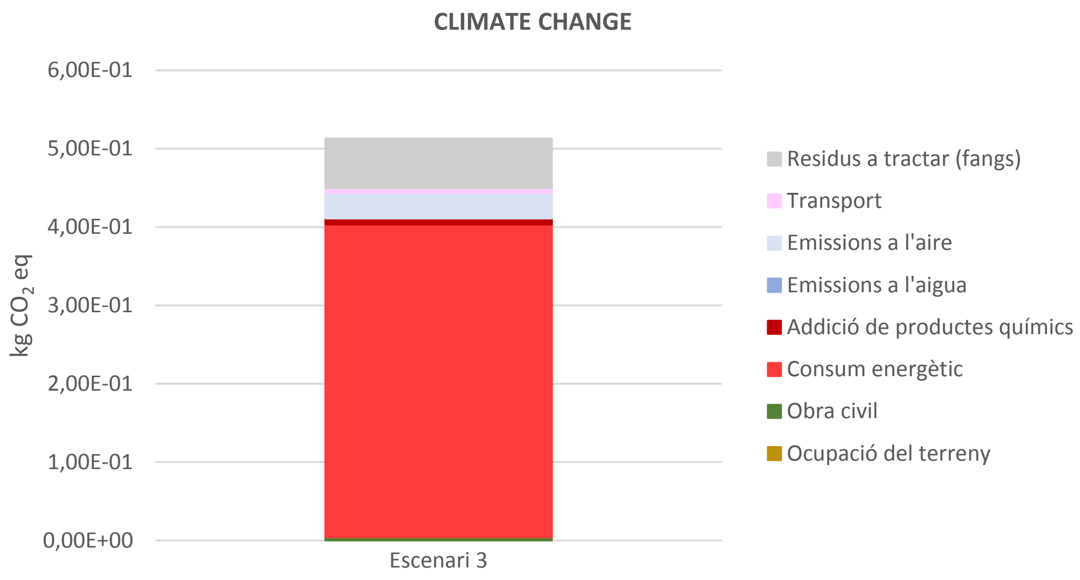
Impact category	Metal Depletion
Unit	kg Fe eq
Total	**1,35E-04**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,35E-04

Impact category	Fossil Depletion
Unit	kg oil eq
Total	**1,39E-03**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,39E-03

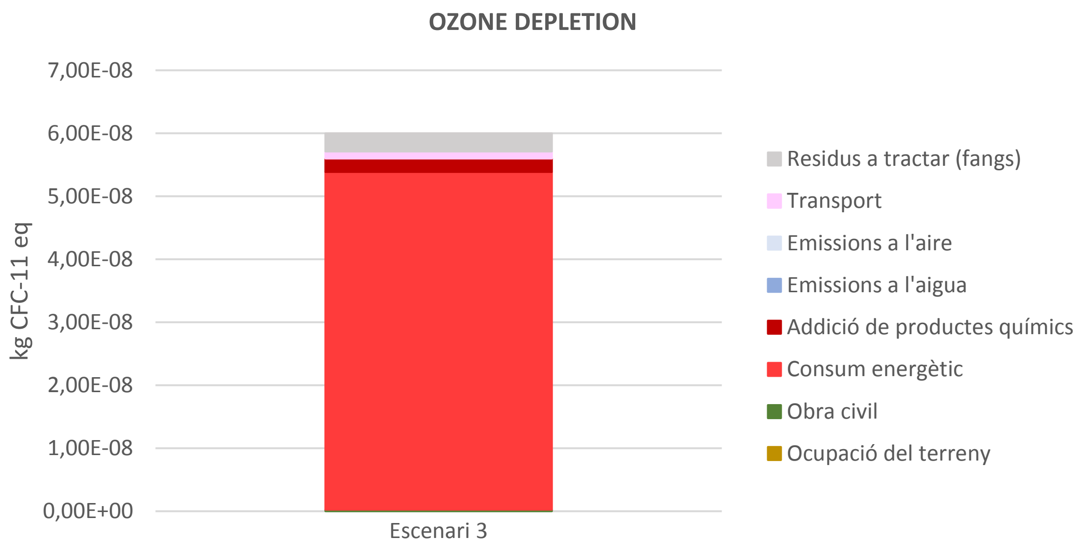
1.3. ESCENARI 3

1.3.0. Base

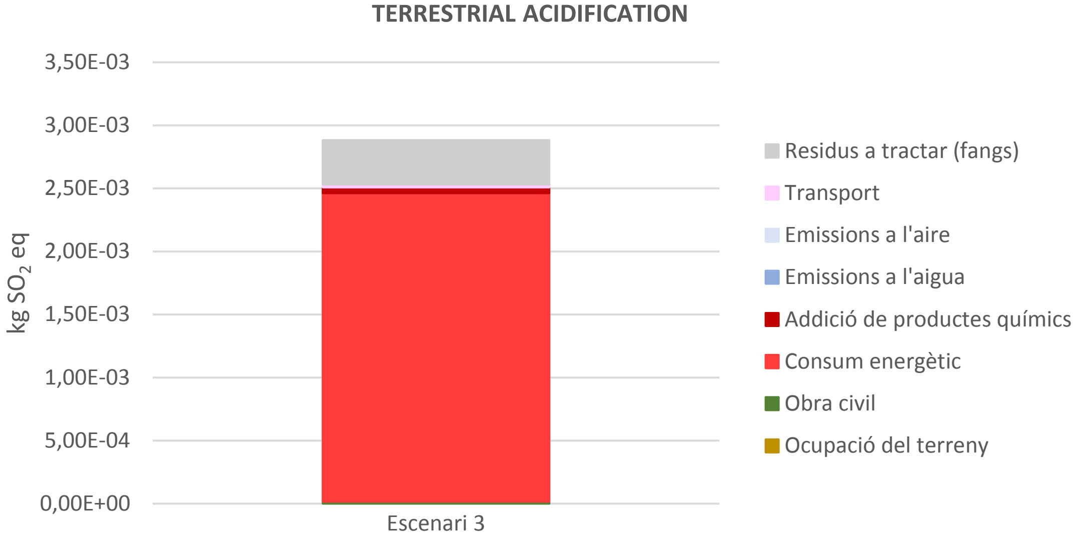
Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**5,13E-01**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	4,39E-03	0,86%
Consum energètic	3,99E-01	77,80%
Addició de productes químics	7,53E-03	1,47%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	3,28E-02	6,39%
Transport	6,18E-03	1,21%
Residus a tractar (fangs)	6,30E-02	12,28%



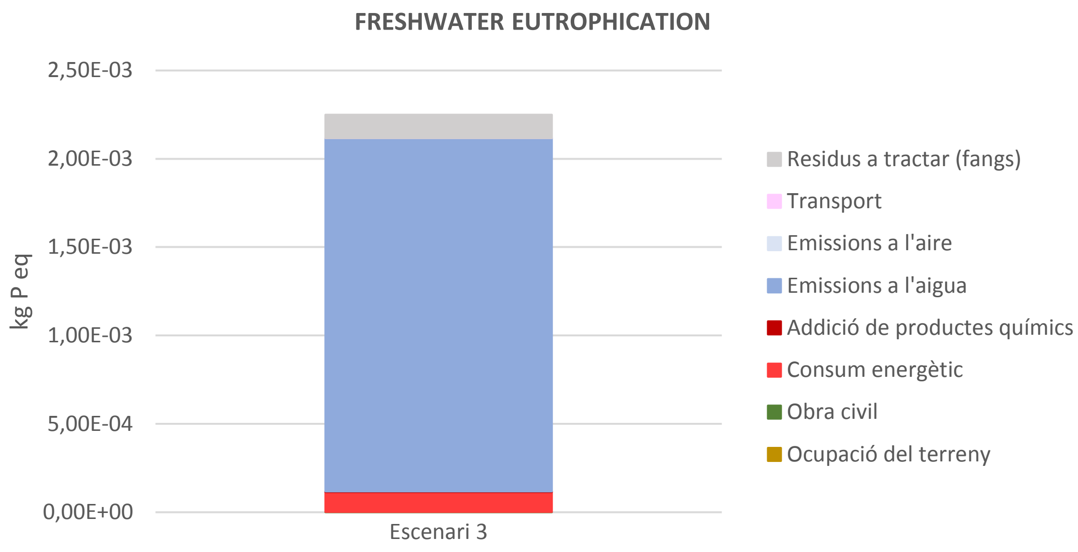
Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**6,00E-08**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	2,38E-10	0,40%
Consum energètic	5,36E-08	89,32%
Addició de productes químics	2,13E-09	3,55%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	1,15E-09	1,91%
Residus a tractar (fangs)	2,90E-09	4,83%



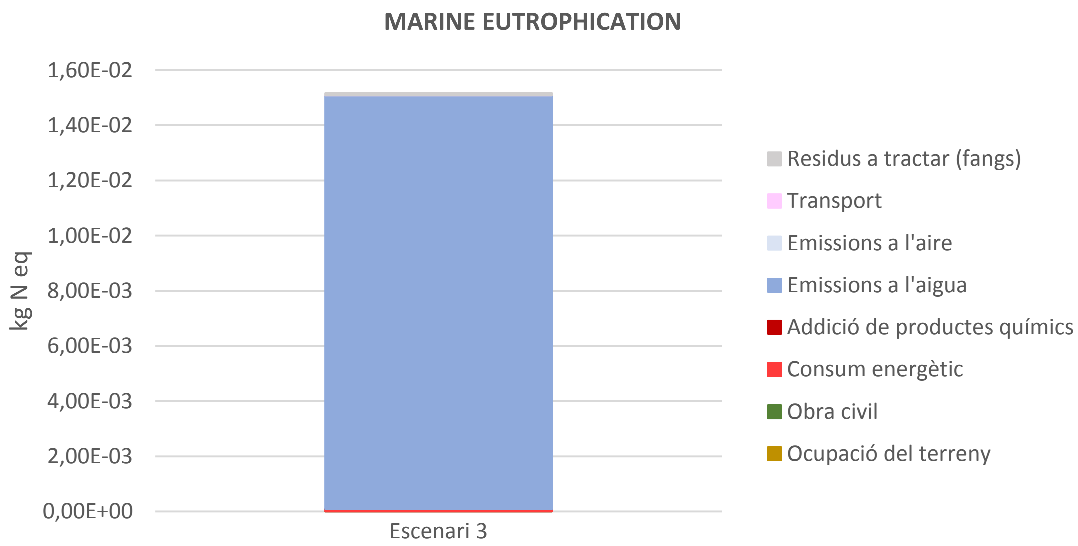
Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**2,88E-03**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	1,35E-05	0,47%
Consum energètic	2,45E-03	84,95%
Addició de productes químics	4,53E-05	1,57%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	2,45E-05	0,85%
Residus a tractar (fangs)	3,50E-04	12,16%



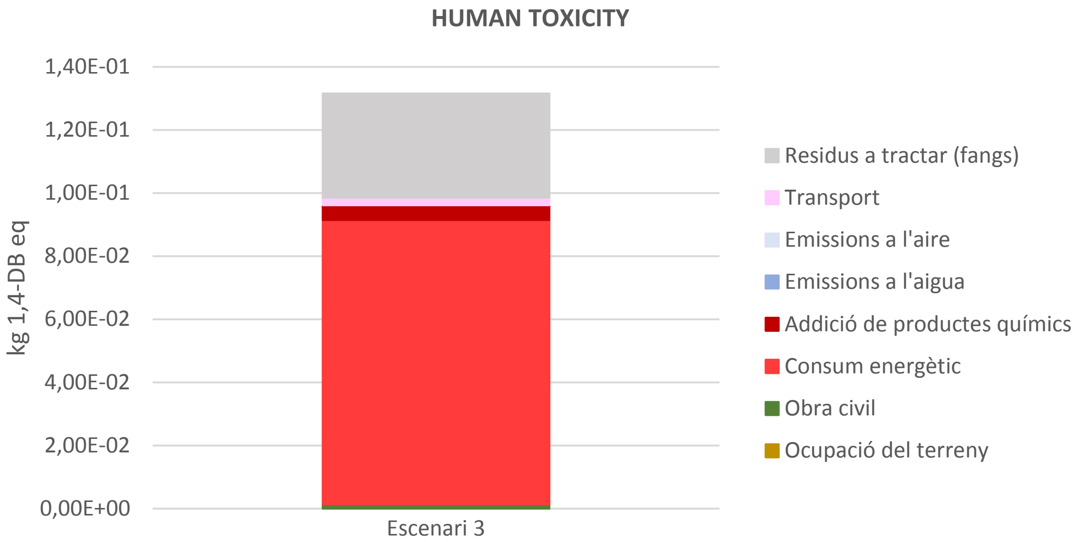
Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**2,25E-03**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	1,20E-06	0,05%
Consum energètic	1,12E-04	4,98%
Addició de productes químics	3,98E-06	0,18%
Emissions a l'aigua	2,00E-03	88,93%
Emissions a l'aire	0,00E+00	0,00%
Transport	4,98E-07	0,02%
Residus a tractar (fangs)	1,31E-04	5,84%



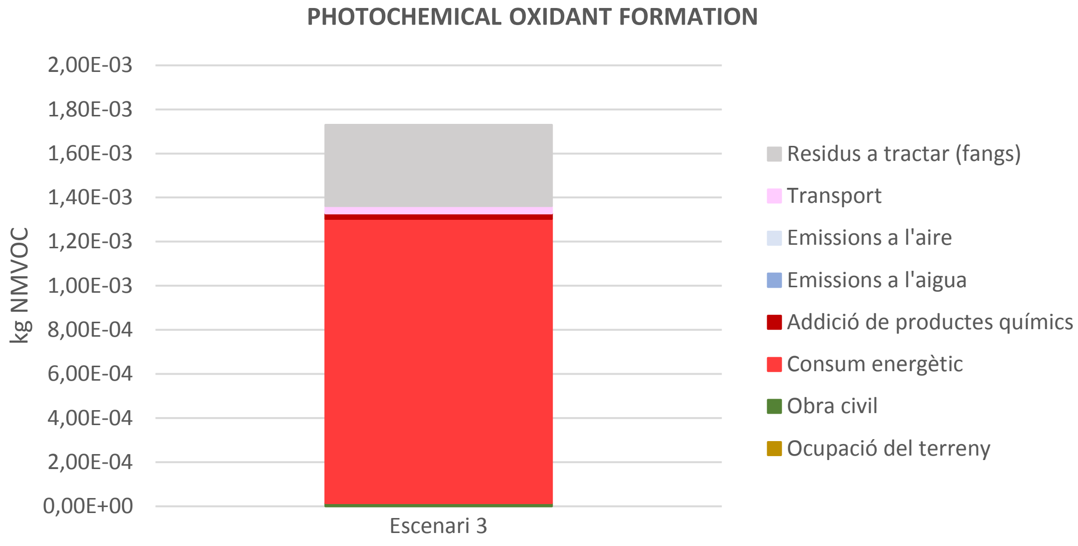
Impact category	Marine Eutrophication	
Unit	**kg N eq**	
Total	**1,52E-02**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	6,14E-07	0,00%
Consum energètic	8,15E-05	0,54%
Addició de productes químics	1,89E-06	0,01%
Emissions a l'aigua	1,50E-02	98,90%
Emissions a l'aire	0,00E+00	0,00%
Transport	1,22E-06	0,01%
Residus a tractar (fangs)	8,14E-05	0,54%



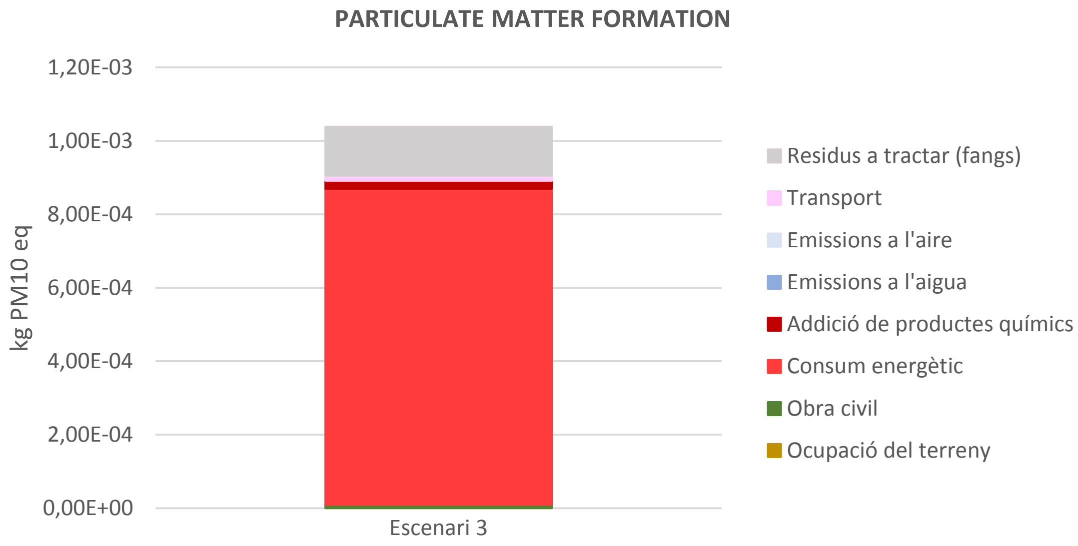
Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**1,32E-01**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	1,43E-03	1,09%
Consum energètic	9,00E-02	68,43%
Addició de productes químics	4,64E-03	3,53%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	2,44E-03	1,85%
Residus a tractar (fangs)	3,30E-02	25,10%



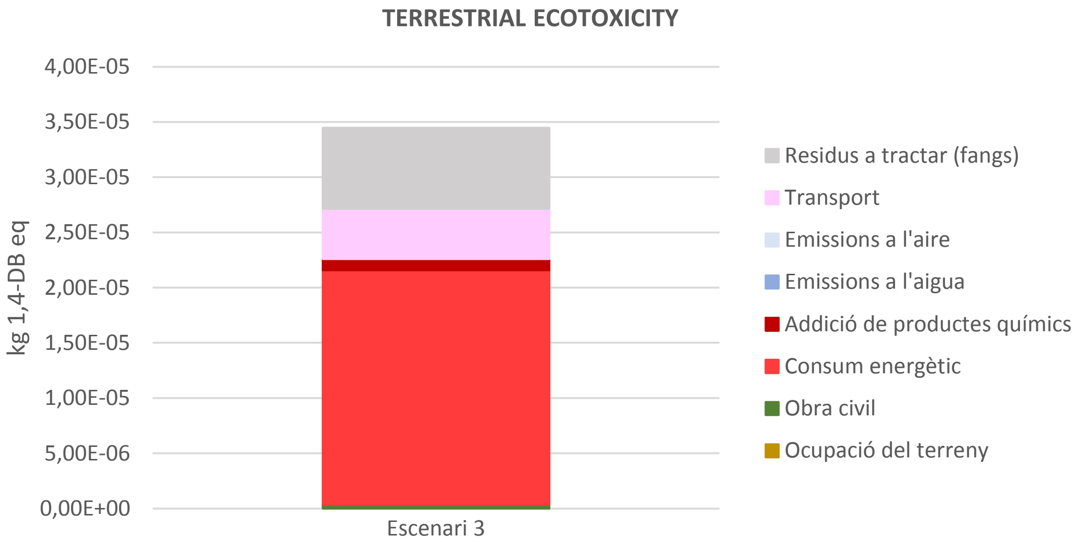
Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**1,73E-03**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	1,44E-05	0,83%
Consum energètic	1,29E-03	74,59%
Addició de productes químics	2,35E-05	1,36%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	3,31E-05	1,91%
Residus a tractar (fangs)	3,68E-04	21,31%



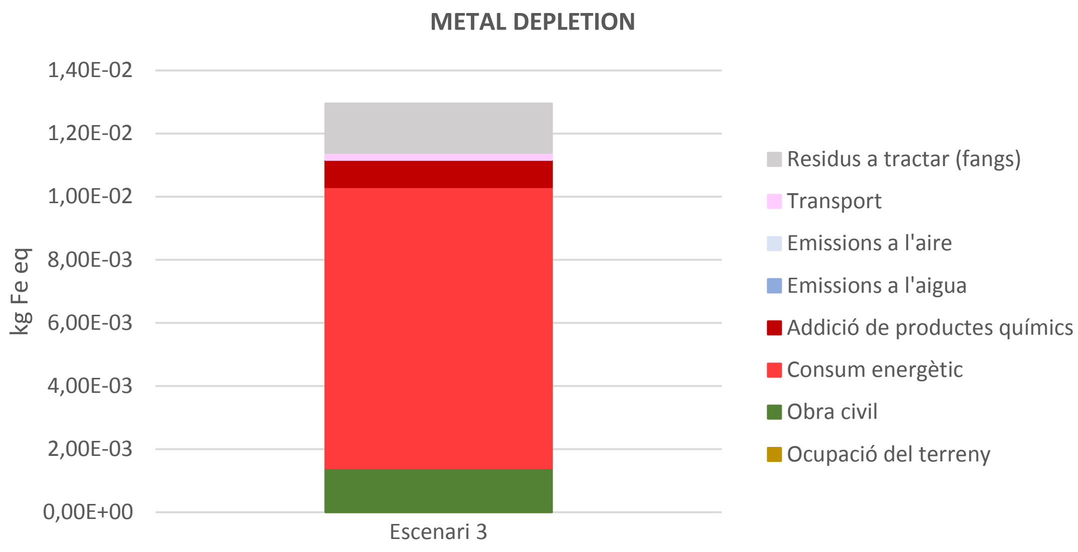
Impact category	**Particulate Matter Formation**	
Unit	**kg PM10 eq**	
Total	**1,04E-03**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	9,35E-06	0,90%
Consum energètic	8,60E-04	82,81%
Addició de productes químics	2,18E-05	2,10%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	1,42E-05	1,36%
Residus a tractar (fangs)	1,33E-04	12,83%



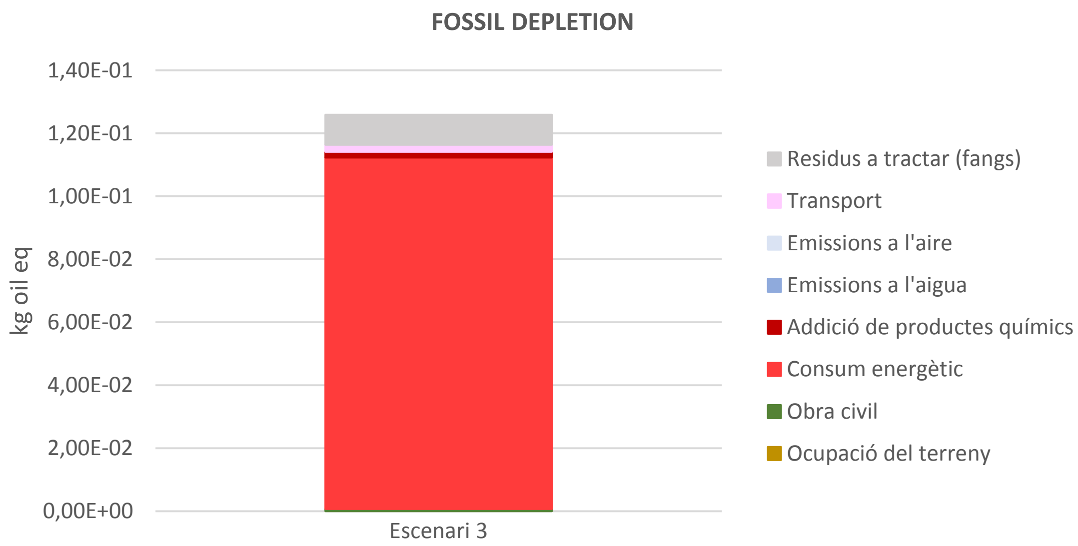
Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**3,45E-05**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	3,52E-07	1,02%
Consum energètic	2,12E-05	61,52%
Addició de productes químics	1,01E-06	2,92%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	4,57E-06	13,25%
Residus a tractar (fangs)	7,34E-06	21,29%



Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**1,30E-02**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	1,40E-03	10,82%
Consum energètic	8,90E-03	68,72%
Addició de productes químics	8,68E-04	6,70%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	2,17E-04	1,67%
Residus a tractar (fangs)	1,57E-03	12,09%



Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**1,26E-01**	%
Ocupació del terreny	0,00E+00	0,00%
Obra civil	7,21E-04	0,57%
Consum energètic	1,12E-01	88,61%
Addició de productes químics	1,87E-03	1,48%
Emissions a l'aigua	0,00E+00	0,00%
Emissions a l'aire	0,00E+00	0,00%
Transport	2,24E-03	1,78%
Residus a tractar (fangs)	9,53E-03	7,56%



1.3.1. Ocupació del terreny

Impact category	Climate Change
Unit	kg CO_2 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Ozone Depletion
Unit	kg CFC-11 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Terrestrial Acidification
Unit	kg SO_2 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Freshwater Eutrophication
Unit	kg P eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Marine Eutrophication
Unit	kg N eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Human Toxicity
Unit	kg 1,4-DB eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Photochemical Oxidant Formation
Unit	kg NMVOC
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Particulate Matter Formation
Unit	kg PM10 eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Terrestrial Ecotoxicity
Unit	kg 1,4-DB eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Metal Depletion
Unit	kg Fe eq
Total	0,00E+00
Land occupation	0,00E+00

Impact category	Fossil Depletion
Unit	kg oil eq
Total	0,00E+00
Land occupation	0,00E+00

1.3.2. Obra civil

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**4,39E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,45E-03	33,17%
Concrete, normal {GLO}| market for | Alloc Def, S	2,93E-03	66,83%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**2,38E-10**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	8,28E-11	34,85%
Concrete, normal {GLO}| market for | Alloc Def, S	1,55E-10	65,15%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**1,35E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	5,91E-06	43,72%
Concrete, normal {GLO}| market for | Alloc Def, S	7,61E-06	56,28%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**1,20E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	8,42E-07	70,04%
Concrete, normal {GLO}| market for | Alloc Def, S	3,60E-07	29,96%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**6,14E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	2,59E-07	42,11%
Concrete, normal {GLO}| market for | Alloc Def, S	3,56E-07	57,89%
Impact category	**Human Toxicity**	
Unit	**kg 1,4-DB eq**	
Total	**1,43E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	9,87E-04	68,97%
Concrete, normal {GLO}| market for | Alloc Def, S	4,44E-04	31,03%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**1,44E-05**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	6,52E-06	45,27%
Concrete, normal {GLO}| market for | Alloc Def, S	7,88E-06	54,73%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**9,35E-06**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	5,60E-06	59,96%
Concrete, normal {GLO}| market for | Alloc Def, S	3,74E-06	40,04%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**3,52E-07**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,36E-07	38,71%
Concrete, normal {GLO}| market for | Alloc Def, S	2,15E-07	61,29%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**1,40E-03**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	1,34E-03	95,66%
Concrete, normal {GLO}| market for | Alloc Def, S	6,08E-05	4,34%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**7,21E-04**	%
Reinforcing steel {GLO}| market for | Alloc Def, S	3,26E-04	45,15%
Concrete, normal {GLO}| market for | Alloc Def, S	3,96E-04	54,85%

1.3.3. Consum energètic (operació)

Impact category	Climate Change
Unit	kg CO_2 eq
Total	**3,99E-01**
Electricity, medium voltage {ES}| market for | Alloc Def, S	3,99E-01

Impact category	Ozone Depletion
Unit	kg CFC-11 eq
Total	**5,36E-08**
Electricity, medium voltage {ES}| market for | Alloc Def, S	5,36E-08

Impact category	Terrestrial Acidification
Unit	kg SO_2 eq
Total	**2,45E-03**
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,45E-03

Impact category	Freshwater Eutrophication
Unit	kg P eq
Total	**1,12E-04**
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,12E-04

Impact category	Marine Eutrophication
Unit	kg N eq
Total	**8,15E-05**
Electricity, medium voltage {ES}| market for | Alloc Def, S	8,15E-05

Impact category	Human Toxicity
Unit	kg 1,4-DB eq
Total	**9,00E-02**
Electricity, medium voltage {ES}| market for | Alloc Def, S	9,00E-02

Impact category	Photochemical Oxidant Formation
Unit	kg NMVOC
Total	**1,29E-03**
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,29E-03

Impact category	Particulate Matter Formation
Unit	kg PM10 eq
Total	**8,60E-04**
Electricity, medium voltage {ES}| market for | Alloc Def, S	8,60E-04

Impact category	Terrestrial Ecotoxicity
Unit	kg 1,4-DB eq
Total	**2,12E-05**
Electricity, medium voltage {ES}| market for | Alloc Def, S	2,12E-05

Impact category	Metal Depletion
Unit	kg Fe eq
Total	**8,90E-03**
Electricity, medium voltage {ES}| market for | Alloc Def, S	8,90E-03

Impact category	Fossil Depletion
Unit	kg oil eq
Total	**1,12E-01**
Electricity, medium voltage {ES}| market for | Alloc Def, S	1,12E-01

1.3.4. Addició de productes químics (operació)

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**7,53E-03**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	4,26E-03	56,58%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	3,27E-03	43,42%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**2,13E-09**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	6,03E-10	28,29%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	1,53E-09	71,71%

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**4,53E-05**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	2,75E-05	60,82%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	1,77E-05	39,18%

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**3,98E-06**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	1,72E-06	43,23%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	2,26E-06	56,77%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**1,89E-06**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	9,96E-07	52,77%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	8,91E-07	47,23%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**4,64E-03**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	1,85E-03	39,82%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	2,79E-03	60,18%

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**2,35E-05**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	1,28E-05	54,45%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	1,07E-05	45,55%

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**2,18E-05**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	1,09E-05	50,10%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	1,09E-05	49,90%

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**1,01E-06**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	5,56E-07	55,12%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	4,53E-07	44,88%

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**8,68E-04**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	2,75E-04	31,72%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	5,93E-04	68,28%

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**1,87E-03**	%
Chemical, inorganic {GLO}| market for chemicals, inorganic | Alloc Def, S	1,04E-03	55,63%
Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Alloc Def, S	8,27E-04	44,37%

1.3.5. Emissions a l'aigua (efluent)

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**2,00E-03**	%
Emission to water COD	0,00E+00	0,00%
Emission to water TSS	0,00E+00	0,00%
Emission to water N	0,00E+00	0,00%
Emission to water P	2,00E-03	100,00%

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**1,50E-02**	%
Emission to water COD	0,00E+00	0,00%
Emission to water TSS	0,00E+00	0,00%
Emission to water N	1,50E-02	100,00%
Emission to water P	0,00E+00	0,00%

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**0,00E+00**	%
Emission to water COD	0,00E+00	-
Emission to water TSS	0,00E+00	-
Emission to water N	0,00E+00	-
Emission to water P	0,00E+00	-

1.3.6. Emissions a l'aire (reactor de fangs activats)

Impact category	Climate Change	
Unit	kg CO_2 eq	
Total	**3,28E-02**	%
Emission to air CO_2	0,00E+00	0,00%
Emission to air N_2O	3,28E-02	100,00%

Impact category	Ozone Depletion	
Unit	kg CFC-11 eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Terrestrial Acidification	
Unit	kg SO_2 eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Freshwater Eutrophication	
Unit	kg P eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Marine Eutrophication	
Unit	kg N eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Human Toxicity	
Unit	kg 1,4-DB eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Photochemical Oxidant Formation	
Unit	kg NMVOC	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Particulate Matter Formation	
Unit	kg PM10 eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Terrestrial Ecotoxicity	
Unit	kg 1,4-DB eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Metal Depletion	
Unit	kg Fe eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

Impact category	Fossil Depletion	
Unit	kg oil eq	
Total	**0,00E+00**	%
Emission to air CO_2	0,00E+00	-
Emission to air N_2O	0,00E+00	-

1.3.7. Transport dels fangs

Impact category	Climate Change
Unit	kg CO_2 eq
Total	**6,18E-03**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	6,18E-03

Impact category	Ozone Depletion
Unit	kg CFC-11 eq
Total	**1,15E-09**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,15E-09

Impact category	Terrestrial Acidification
Unit	kg SO_2 eq
Total	**2,45E-05**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	2,45E-05

Impact category	Freshwater Eutrophication
Unit	kg P eq
Total	**4,98E-07**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	4,98E-07

Impact category	Marine Eutrophication
Unit	kg N eq
Total	**1,22E-06**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,22E-06

Impact category	Human Toxicity
Unit	kg 1,4-DB eq
Total	**2,44E-03**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	2,44E-03

Impact category	Photochemical Oxidant Formation
Unit	kg NMVOC
Total	**3,31E-05**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	3,31E-05

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**1,42E-05**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	1,42E-05

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**4,57E-06**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	4,57E-06

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**2,17E-04**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	2,17E-04

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**2,24E-03**
Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Def, S	2,24E-03

1.3.8. Residus a tractar (fangs)

Impact category	Climate Change
Unit	**kg CO_2 eq**
Total	**6,30E-02**
Raw sewage sludge	6,30E-02

Impact category	Ozone Depletion
Unit	**kg CFC-11 eq**
Total	**2,90E-09**
Raw sewage sludge	2,90E-09

Impact category	Terrestrial Acidification
Unit	**kg SO_2 eq**
Total	**3,50E-04**
Raw sewage sludge	3,50E-04

Impact category	Freshwater Eutrophication
Unit	**kg P eq**
Total	**1,31E-04**
Raw sewage sludge	1,31E-04

Impact category	Marine Eutrophication
Unit	**kg N eq**
Total	**8,14E-05**
Raw sewage sludge	8,14E-05

Impact category	Human Toxicity
Unit	**kg 1,4-DB eq**
Total	**3,30E-02**
Raw sewage sludge	3,30E-02

Impact category	Photochemical Oxidant Formation
Unit	**kg NMVOC**
Total	**3,68E-04**
Raw sewage sludge	3,68E-04

Impact category	Particulate Matter Formation
Unit	**kg PM10 eq**
Total	**1,33E-04**
Raw sewage sludge	1,33E-04

Impact category	Terrestrial Ecotoxicity
Unit	**kg 1,4-DB eq**
Total	**7,34E-06**
Raw sewage sludge	7,34E-06

Impact category	Metal Depletion
Unit	**kg Fe eq**
Total	**1,57E-03**
Raw sewage sludge	1,57E-03

Impact category	Fossil Depletion
Unit	**kg oil eq**
Total	**9,53E-03**
Raw sewage sludge	9,53E-03

2. RESULTATS DE LA NORMALITZACIÓ

2.1. TAULA COMPARATIVA DELS IMPACTES TOTALS DELS ESCENARIS 1, 2 I 3

Impact category	Unitats	ESCENARI 1	ESCENARI 2	ESCENARI 3
Climate Change	kg CO_2 eq	-8,07E-02	2,49E-01	5,13E-01
Ozone Depletion	kg CFC-11 eq	-3,39E-08	1,32E-08	6,00E-08
Terrestrial Acidification	kg SO_2 eq	2,39E-02	1,65E-02	2,88E-03
Freshwater Eutrophication	kg P eq	3,68E-03	1,07E-03	2,25E-03
Marine Eutrophication	kg N eq	1,03E-02	2,62E-03	1,52E-02
Human Toxicity	kg 1,4-DB eq	8,64E-01	1,42E-01	1,32E-01
Photochemical Oxidant Formation	kg NMVOC	1,41E-04	8,12E-04	1,73E-03
Particulate Matter Formation	kg PM10 eq	3,23E-03	2,56E-03	1,04E-03
Terrestrial Ecotoxicity	kg 1,4-DB eq	1,81E-03	2,60E-04	3,45E-05
Metal Depletion	kg Fe eq	8,25E-02	6,95E-02	1,30E-02
Fossil Depletion	kg oil eq	-7,41E-02	5,08E-02	1,26E-01

2.2. FACTORS DE NORMALITZACIÓ

Climate Change	8,92E-05
Ozone Depletion	4,54E+01
Terrestrial Acidification	2,91E-02
Freshwater Eutrophication	2,41E+00
Marine Eutrophication	9,88E-02
Human Toxicity	1,59E-03
Photochemical Oxidant Formation	1,76E-02
Particulate Matter Formation	6,71E-02
Terrestrial Ecotoxicity	1,21E-01
Metal Depletion	1,40E-03
Fossil Depletion	6,43E-04

2.3. RESULTATS DE NORMALITZACIÓ

Impact category	ESCENARI 1	ESCENARI 2	ESCENARI 3
Climate Change	-7,20E-06	2,22E-05	4,57E-05
Ozone Depletion	-1,54E-06	5,99E-07	2,72E-06
Terrestrial Acidification	6,95E-04	4,80E-04	8,38E-05
Freshwater Eutrophication	8,87E-03	2,57E-03	5,42E-03
Marine Eutrophication	1,02E-03	2,59E-04	1,50E-03
Human Toxicity	1,37E-03	2,26E-04	2,09E-04
Photochemical Oxidant Formation	2,48E-06	1,43E-05	3,04E-05
Particulate Matter Formation	2,17E-04	1,72E-04	6,97E-05
Terrestrial Ecotoxicity	2,20E-04	3,14E-05	4,17E-06
Metal Depletion	1,16E-04	9,73E-05	1,81E-05
Fossil Depletion	-4,76E-05	3,27E-05	8,10E-05

3. RESULTATS DE L'ANÀLISI DE SENSIBILITAT

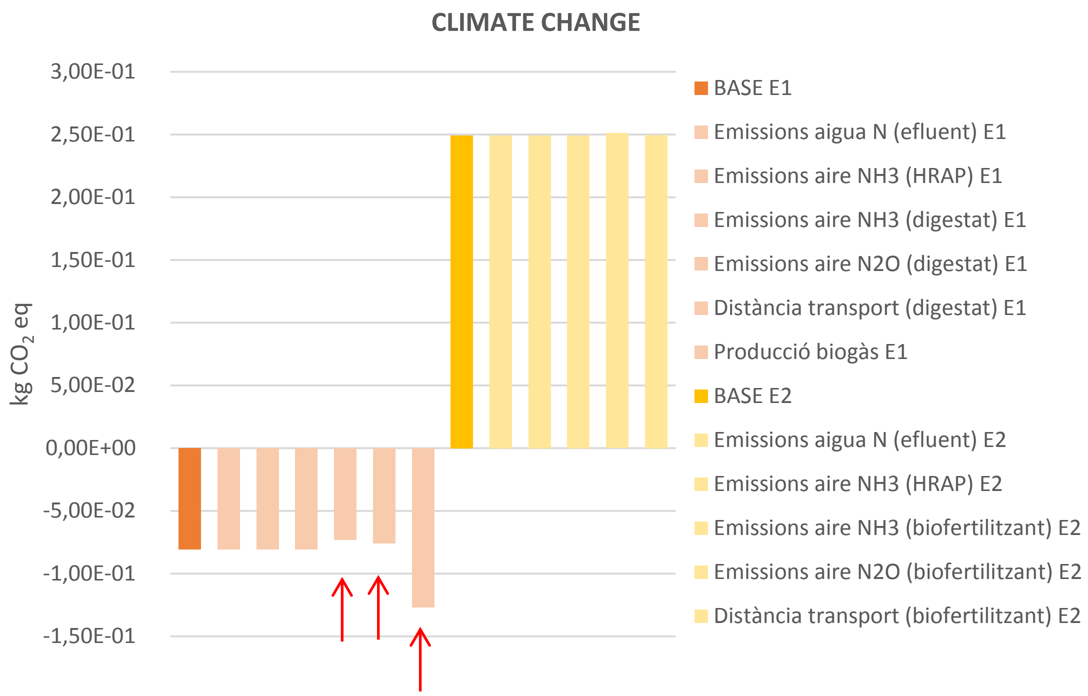
3.1. ESCENARI 1

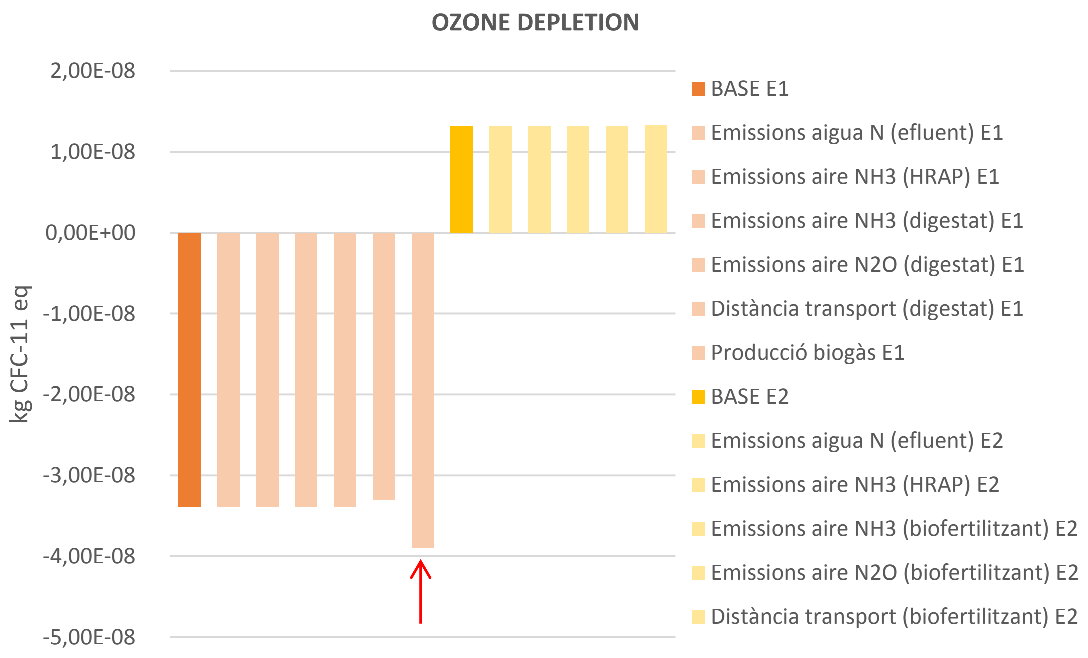
Impact category	Unit	BASE E1	Emissions aigua N (efluent) E1	Emissions aire NH_3 (HRAP) E1	Emissions aire NH_3 (digestat) E1	Emissions aire N_2O (digestat) E1	Distància transport (digestat) E1	Producció biogás E1
Climate Change	kg CO_2 eq	-8,070E-02	-8,070E-02	-8,070E-02	-8,070E-02	-7,299E-02	-7,614E-02	-1,269E-01
Ozone Depletion	kg CFC-11 eq	-3,388E-08	-3,388E-08	-3,388E-08	-3,388E-08	-3,388E-08	-3,304E-08	-3,899E-08
Terrestrial Acidification	kg SO_2 eq	2,388E-02	2,388E-02	2,481E-02	2,547E-02	2,388E-02	2,390E-02	2,368E-02
Freshwater Eutrophication	kg P eq	3,679E-03	3,679E-03	3,679E-03	3,679E-03	3,679E-03	3,679E-03	3,670E-03
Marine Eutrophication	kg N eq	1,028E-02	1,122E-02	1,032E-02	1,034E-02	1,028E-02	1,028E-02	1,028E-02
Human Toxicity	kg 1,4-DB eq	8,640E-01	8,640E-01	8,640E-01	8,640E-01	8,640E-01	8,658E-01	8,550E-01
Photochemical Oxidant Formation	kg NMVOC	1,407E-04	1,407E-04	1,407E-04	1,407E-04	1,407E-04	1,651E-04	4,550E-05
Particulate Matter Formation	kg PM10 eq	3,231E-03	3,231E-03	3,353E-03	3,438E-03	3,231E-03	3,242E-03	3,166E-03
Terrestrial Ecotoxicity	kg 1,4-DB eq	1,815E-03	1,815E-03	1,815E-03	1,815E-03	1,815E-03	1,818E-03	1,812E-03
Metal Depletion	kg Fe eq	8,254E-02	8,254E-02	8,254E-02	8,254E-02	8,254E-02	8,270E-02	8,144E-02
Fossil Depletion	kg oil eq	-7,409E-02	-7,409E-02	-7,409E-02	-7,409E-02	-7,409E-02	-7,245E-02	-8,854E-02

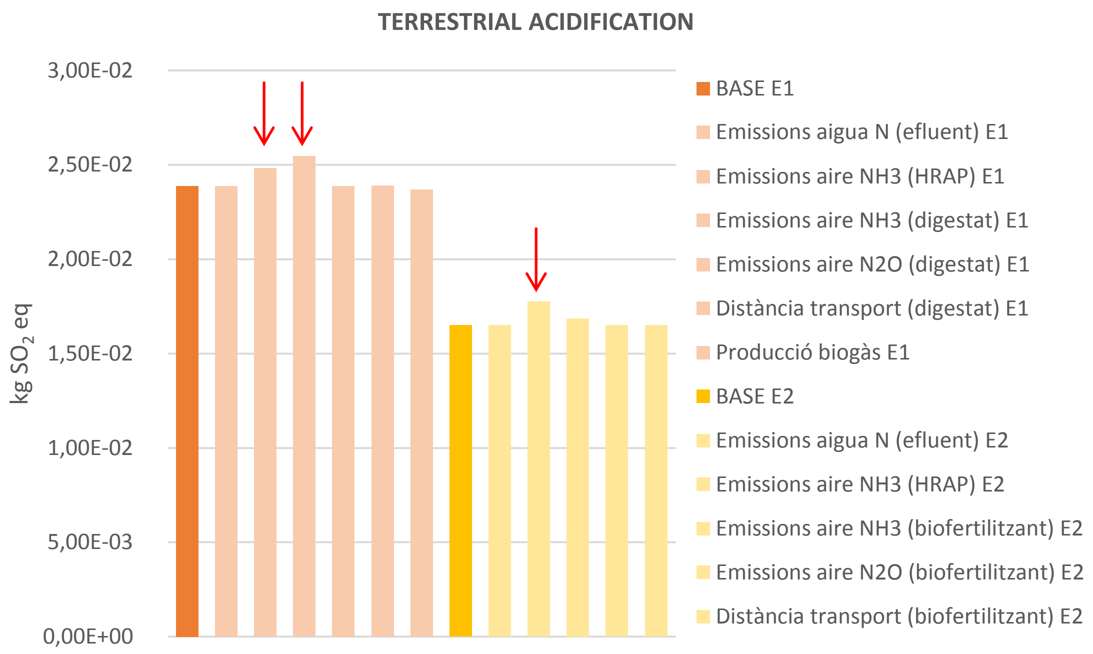
3.2. ESCENARI 2

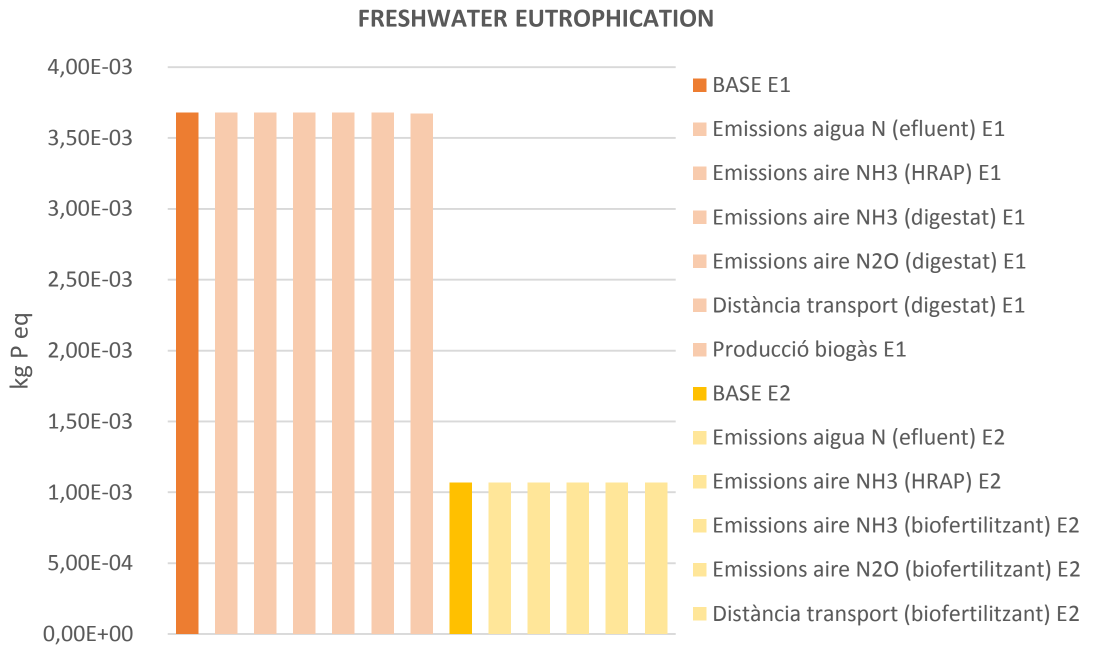
Impact category	Unit	BASE E2	Emissions aigua N (efluent) E2	Emissions aire NH_3 (HRAP) E2	Emissions aire NH_3 (biofertilitzant) E2	Emissions aire N_2O (biofertilitzant) E2	Distància transport (biofertilitzant) E2
Climate Change	kg CO_2 eq	2,492E-01	2,492E-01	2,492E-01	2,492E-01	2,509E-01	2,496E-01
Ozone Depletion	kg CFC-11 eq	1,320E-08	1,320E-08	1,320E-08	1,320E-08	1,320E-08	1,327E-08
Terrestrial Acidification	kg SO_2 eq	1,651E-02	1,651E-02	1,774E-02	1,686E-02	1,651E-02	1,651E-02
Freshwater Eutrophication	kg P eq	1,067E-03	1,067E-03	1,067E-03	1,067E-03	1,067E-03	1,067E-03
Marine Eutrophication	kg N eq	2,622E-03	2,822E-03	2,668E-03	2,636E-03	2,622E-03	2,622E-03
Human Toxicity	kg 1,4-DB eq	1,424E-01	1,424E-01	1,424E-01	1,424E-01	1,424E-01	1,426E-01
Photochemical Oxidant Formation	kg NMVOC	8,122E-04	8,122E-04	8,122E-04	8,122E-04	8,122E-04	8,142E-04
Particulate Matter Formation	kg PM10 eq	2,557E-03	2,557E-03	2,717E-03	2,604E-03	2,557E-03	2,558E-03
Terrestrial Ecotoxicity	kg 1,4-DB eq	2,598E-04	2,598E-04	2,598E-04	2,598E-04	2,598E-04	2,601E-04
Metal Depletion	kg Fe eq	6,948E-02	6,948E-02	6,948E-02	6,948E-02	6,948E-02	6,950E-02
Fossil Depletion	kg oil eq	5,085E-02	5,085E-02	5,085E-02	5,085E-02	5,085E-02	5,099E-02

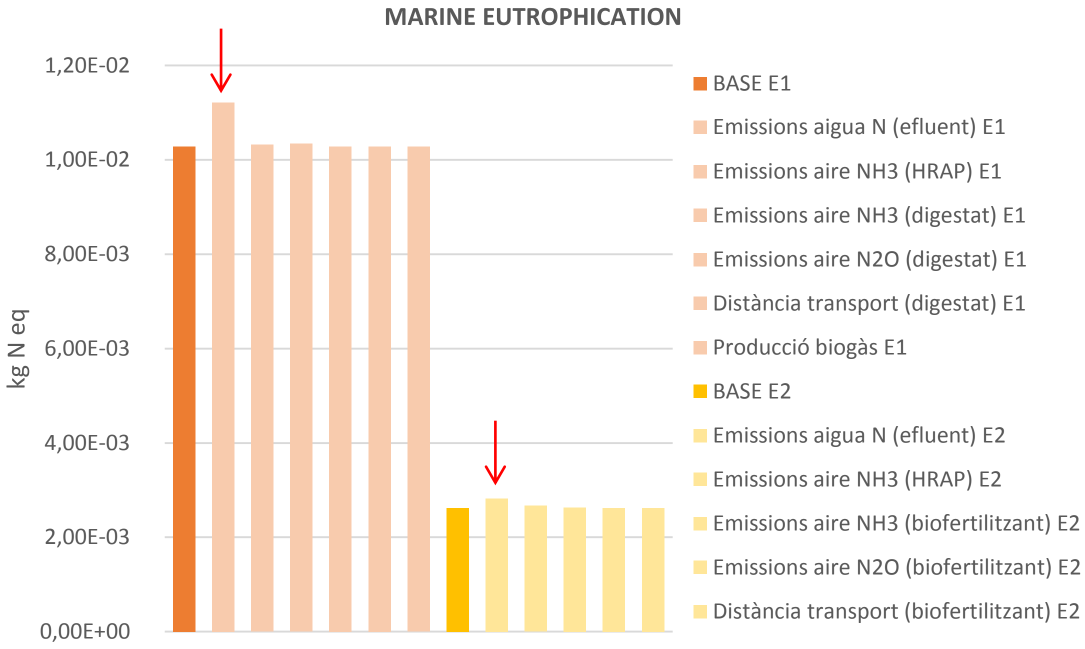
3.3. GRÀFICS


CLIMATE CHANGE
kg CO_2 eq
3,00E-01
2,50E-01
2,00E-01
1,50E-01
1,00E-01
5,00E-02
0,00E+00
-5,00E-02
-1,00E-01
-1,50E-01
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2

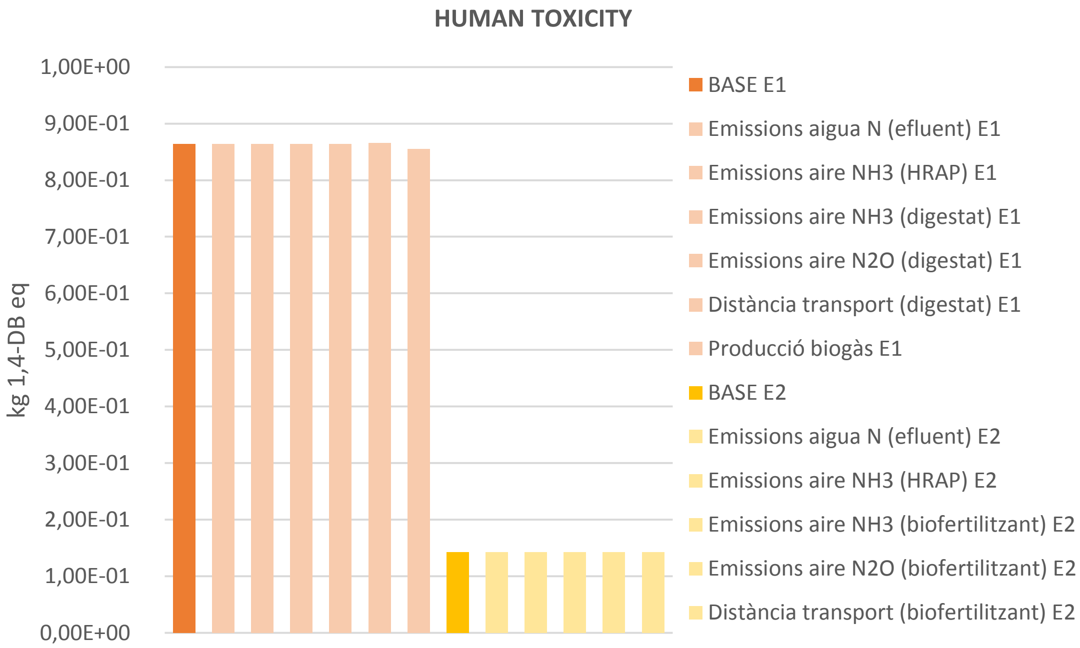

OZONE DEPLETION
kg CFC-11 eq
2,00E-08
1,00E-08
0,00E+00
-1,00E-08
-2,00E-08
-3,00E-08
-4,00E-08
-5,00E-08
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2


TERRESTRIAL ACIDIFICATION
kg SO2 eq
3,00E-02
2,50E-02
2,00E-02
1,50E-02
1,00E-02
5,00E-03
0,00E+00
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2

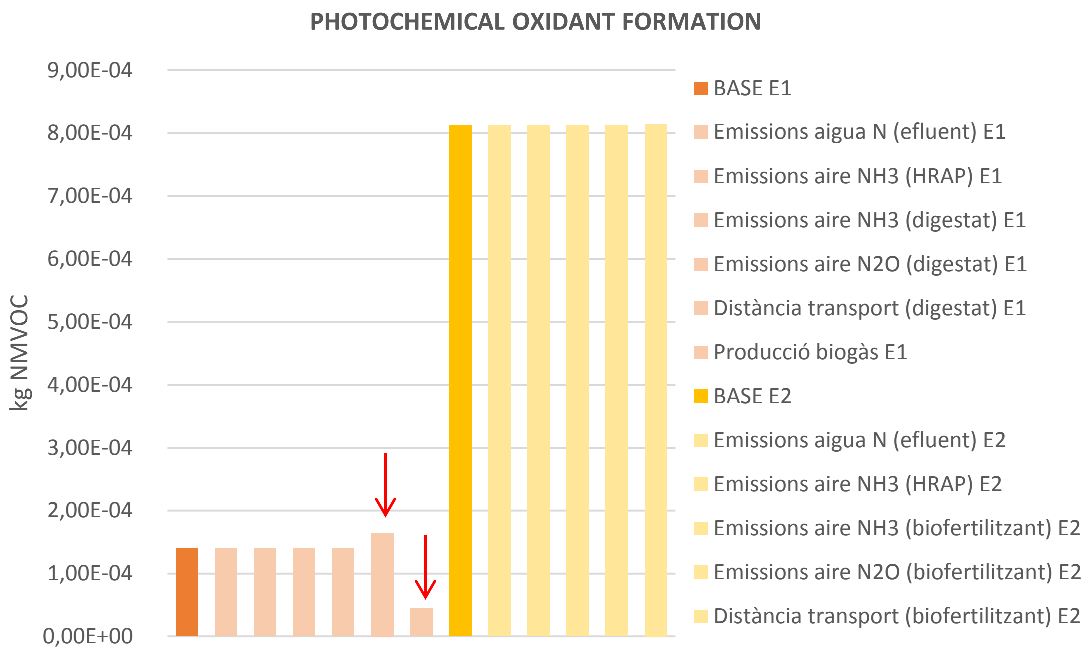

FRESHWATER EUTROPHICATION
kg P eq
4,00E-03
3,50E-03
3,00E-03
2,50E-03
2,00E-03
1,50E-03
1,00E-03
5,00E-04
0,00E+00
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2

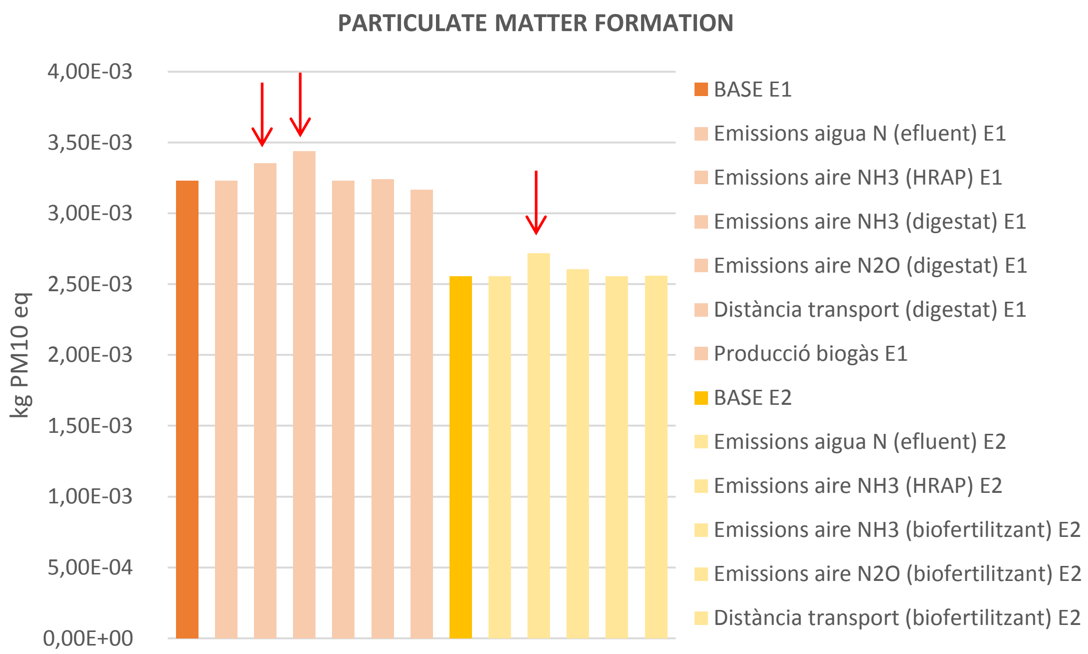


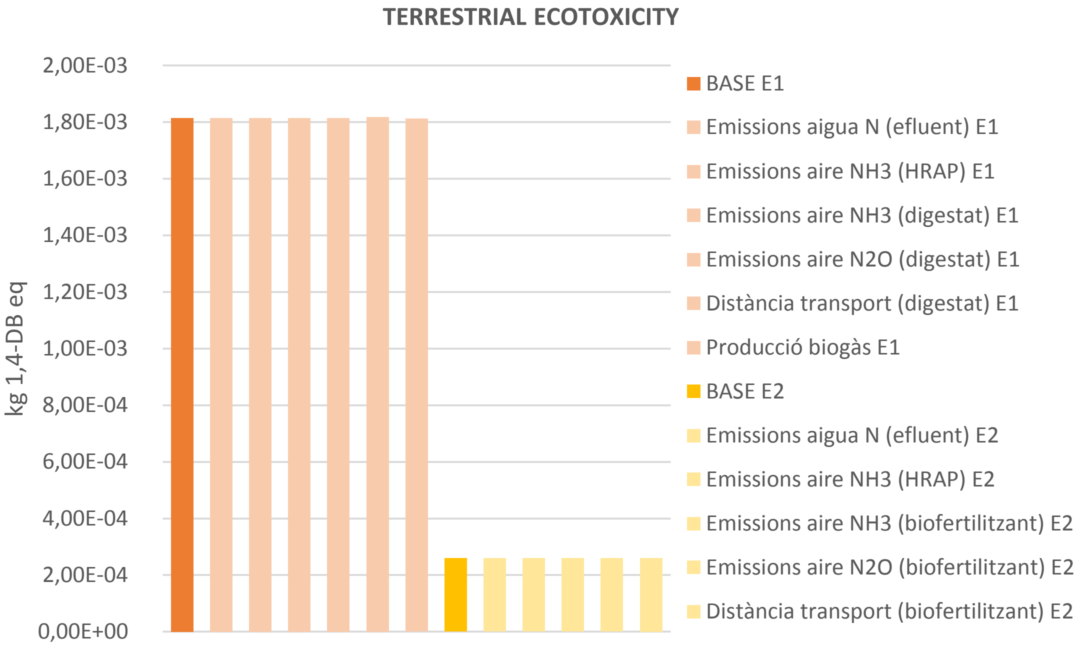
MARINE EUTROPHICATION
1,20E-02
1,00E-02
8,00E-03
6,00E-03
4,00E-03
2,00E-03
0,00E+00
kg N eq
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2

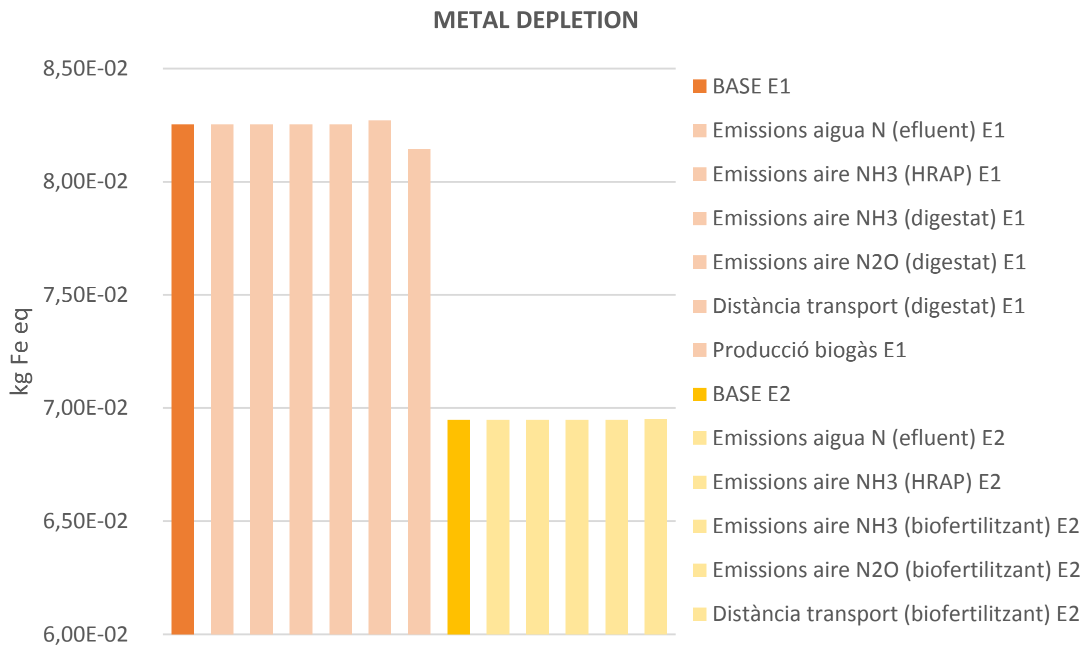


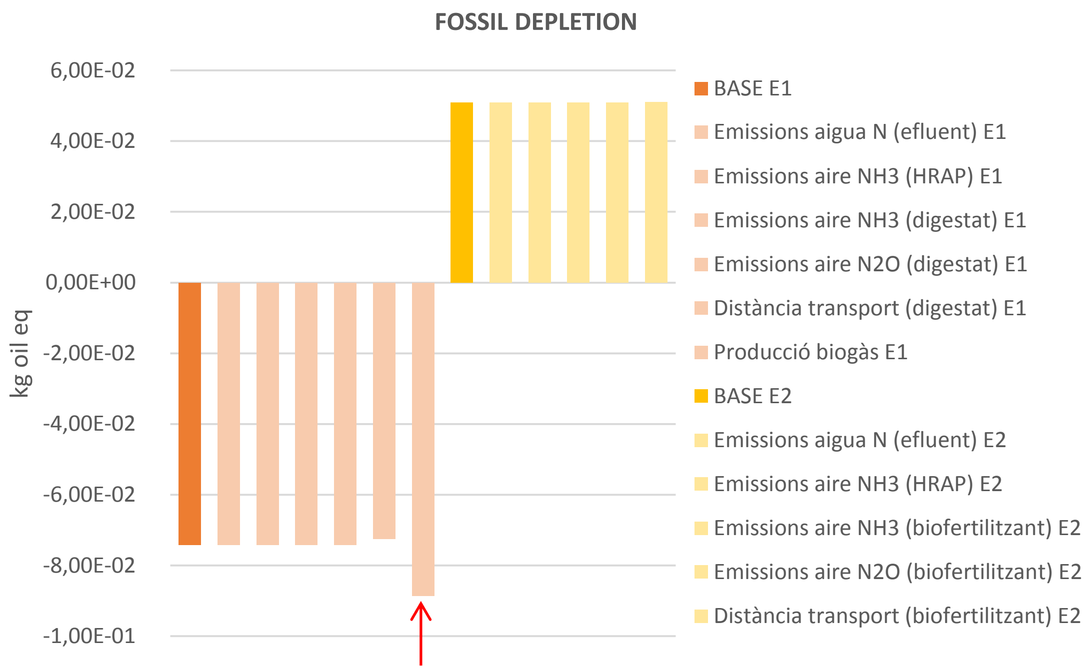
HUMAN TOXICITY
1,00E+00
9,00E-01
8,00E-01
7,00E-01
6,00E-01
5,00E-01
4,00E-01
3,00E-01
2,00E-01
1,00E-01
0,00E+00
kg 1,4-DB eq
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2


PHOTOCHEMICAL OXIDANT FORMATION
kg NMVOC
9,00E-04
8,00E-04
7,00E-04
6,00E-04
5,00E-04
4,00E-04
3,00E-04
2,00E-04
1,00E-04
0,00E+00
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2


PARTICULATE MATTER FORMATION
kg PM10 eq
4,00E-03
3,50E-03
3,00E-03
2,50E-03
2,00E-03
1,50E-03
1,00E-03
5,00E-04
0,00E+00
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2


TERRESTRIAL ECOTOXICITY
kg 1,4-DB eq
2,00E-03
1,80E-03
1,60E-03
1,40E-03
1,20E-03
1,00E-03
8,00E-04
6,00E-04
4,00E-04
2,00E-04
0,00E+00
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2

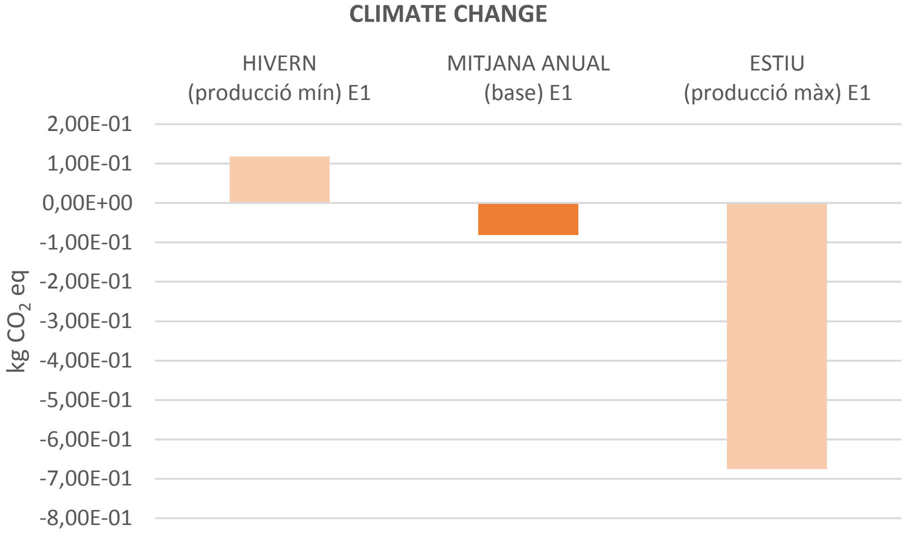

METAL DEPLETION
kg Fe eq
8,50E-02
8,00E-02
7,50E-02
7,00E-02
6,50E-02
6,00E-02
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2


FOSSIL DEPLETION
6,00E-02
4,00E-02
2,00E-02
0,00E+00
-2,00E-02
-4,00E-02
-6,00E-02
-8,00E-02
-1,00E-01
kg oil eq
BASE E1
Emissions aigua N (efluent) E1
Emissions aire NH3 (HRAP) E1
Emissions aire NH3 (digestat) E1
Emissions aire N2O (digestat) E1
Distància transport (digestat) E1
Producció biogàs E1
BASE E2
Emissions aigua N (efluent) E2
Emissions aire NH3 (HRAP) E2
Emissions aire NH3 (biofertilitzant) E2
Emissions aire N2O (biofertilitzant) E2
Distància transport (biofertilitzant) E2

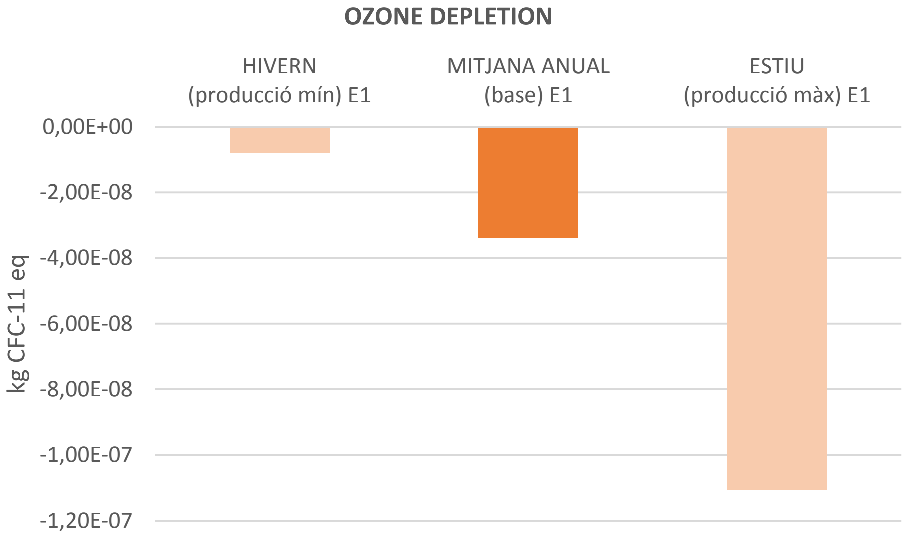
4. RESULTATS DE L'AVALUACIÓ DE L'ESTACIONALITAT

4.1. ESCENARI 1

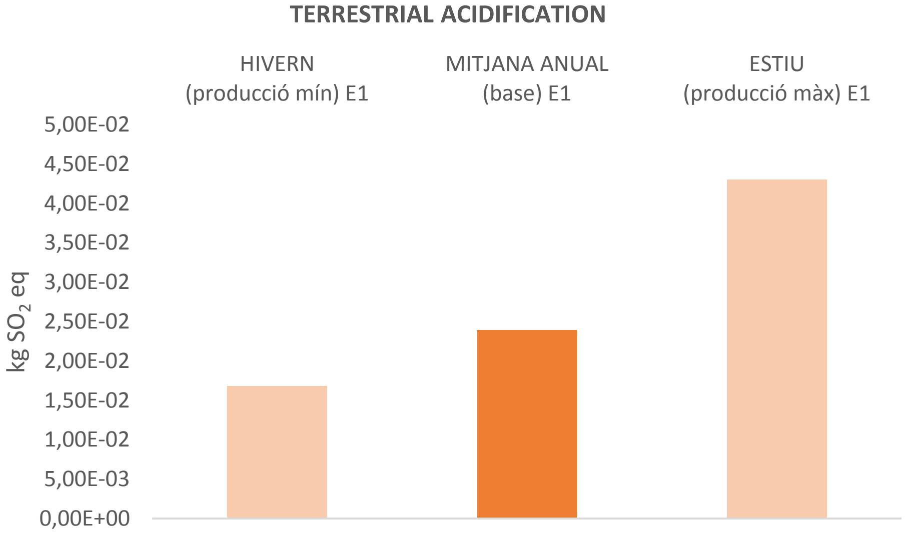
Impact category	Climate Change	Increase/reduction in comparison with the base scenario	
Unit	kg CO_2 eq	%	ratio
HIVERN (producció mín) E1	1,18E-01	-246,56%	-1,47
MITJANA ANUAL (base) E1	-8,07E-02	-	
ESTIU (producció màx) E1	-6,74E-01	735,09%	8,35



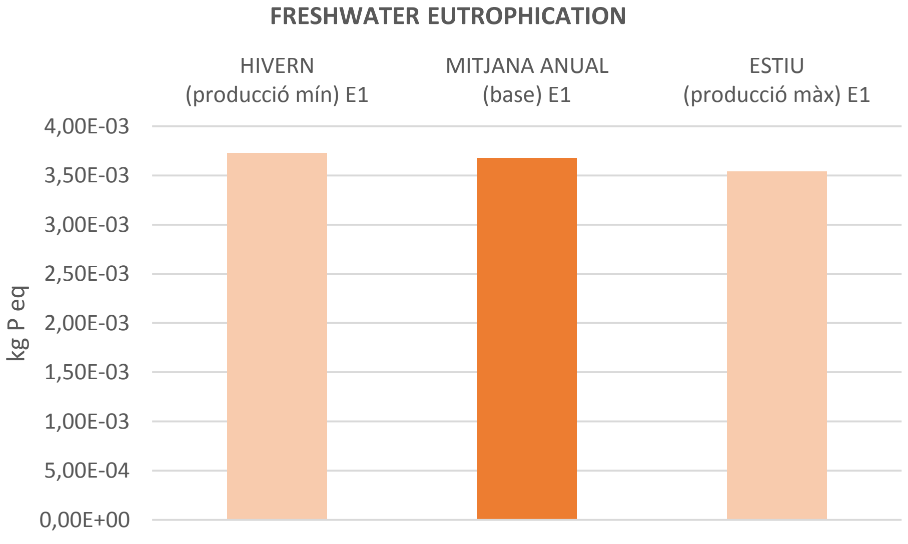
Impact category	Ozone Depletion	Increase/reduction in comparison with the base scenario	
Unit	kg CFC-11 eq	%	ratio
HIVERN (producció mín) E1	-7,99E-09	-76,41%	0,24
MITJANA ANUAL (base) E1	-3,39E-08	-	
ESTIU (producció màx) E1	-1,11E-07	226,50%	3,27



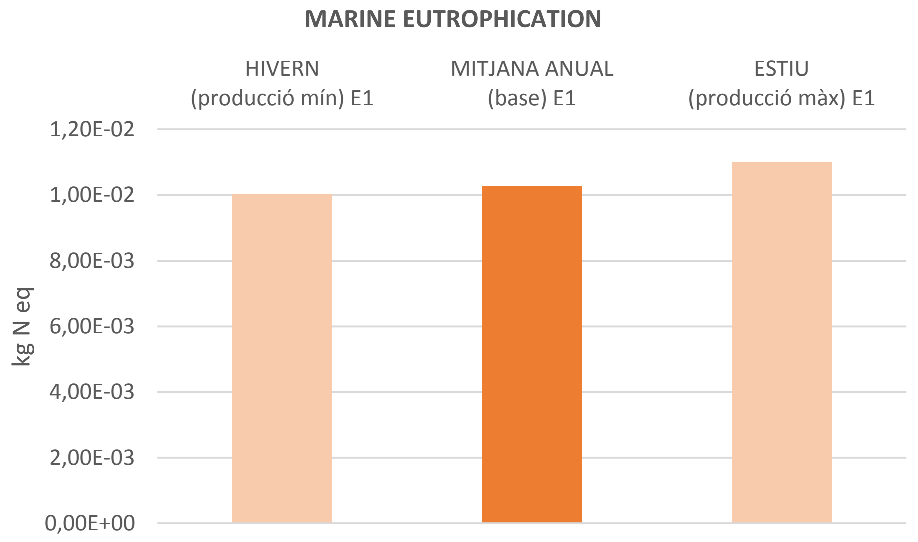
Impact category	Terrestrial Acidification	Increase/reduction in comparison with the base scenario	
Unit	**kg SO_2 eq**	**%**	**ratio**
HIVERN (producció mín) E1	1,68E-02	-29,47%	0,71
MITJANA ANUAL (base) E1	2,39E-02	-	
ESTIU (producció màx) E1	4,30E-02	80,01%	1,80



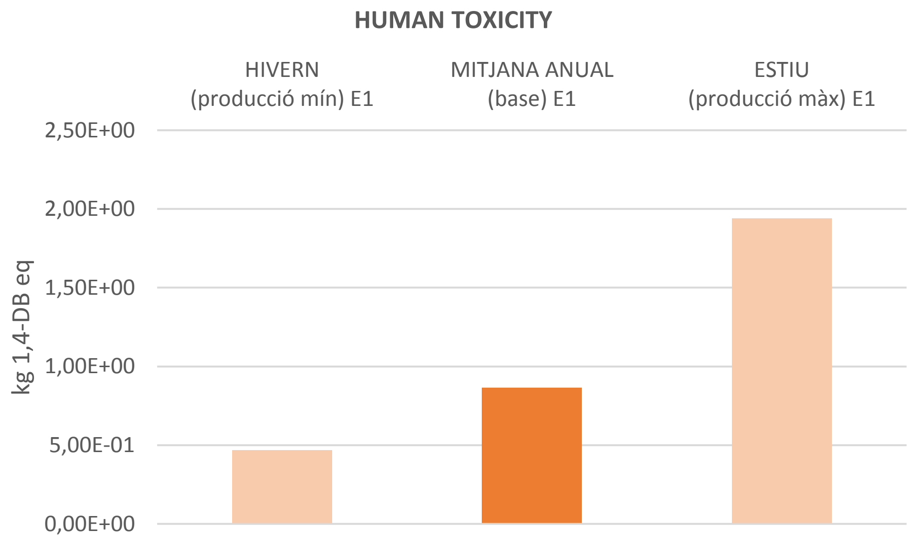
Impact category	Freshwater Eutrophication	Increase/reduction in comparison with the base scenario	
Unit	**kg P eq**	**%**	**ratio**
HIVERN (producció mín) E1	3,73E-03	1,27%	1,01
MITJANA ANUAL (base) E1	3,68E-03	-	
ESTIU (producció màx) E1	3,54E-03	-3,78%	0,96



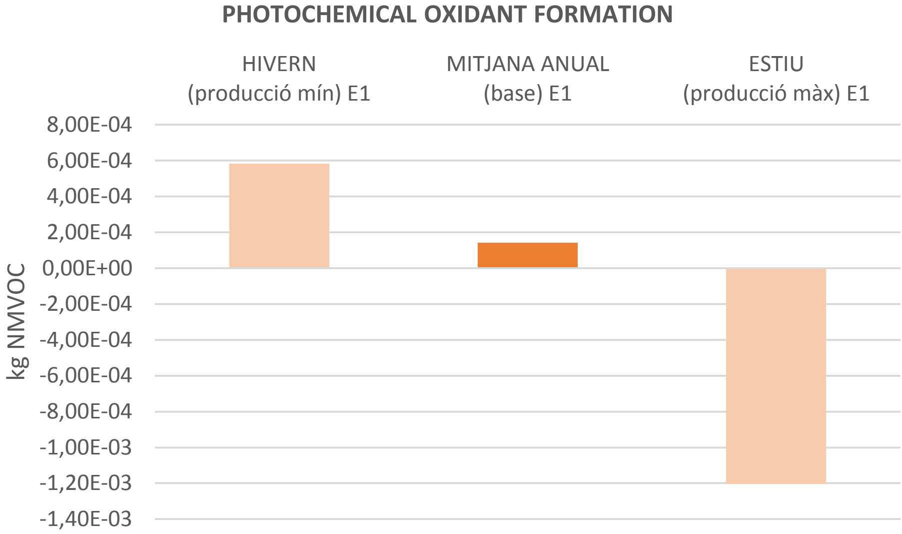
Impact category	Marine Eutrophication	Increase/reduction in comparison with the base scenario	
Unit	**kg N eq**	**%**	**ratio**
HIVERN (producció mín) E1	1,00E-02	-2,59%	0,97
MITJANA ANUAL (base) E1	1,03E-02	-	
ESTIU (producció màx) E1	1,10E-02	7,04%	1,07



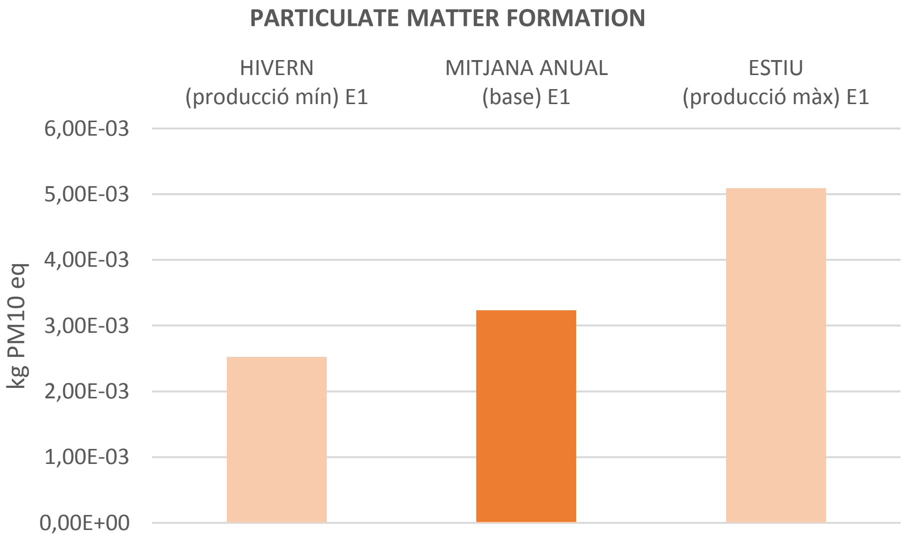
Impact category	Human Toxicity	Increase/reduction in comparison with the base scenario	
Unit	**kg 1,4-DB eq**	**%**	**ratio**
HIVERN (producció mín) E1	4,70E-01	-45,64%	0,54
MITJANA ANUAL (base) E1	8,64E-01	-	
ESTIU (producció màx) E1	1,94E+00	124,47%	2,24



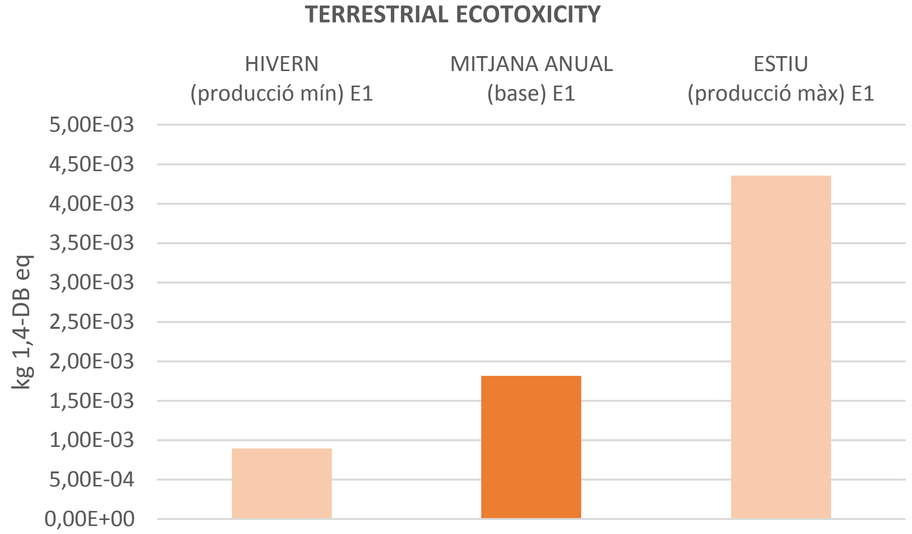
Impact category	Photochemical Oxidant Formation	Increase/reduction in comparison with the base scenario	
Unit	**kg NMVOC**	**%**	**ratio**
HIVERN (producció mín) E1	5,83E-04	314,53%	4,15
MITJANA ANUAL (base) E1	1,41E-04	-	
ESTIU (producció màx) E1	-1,20E-03	-954,08%	-8,54



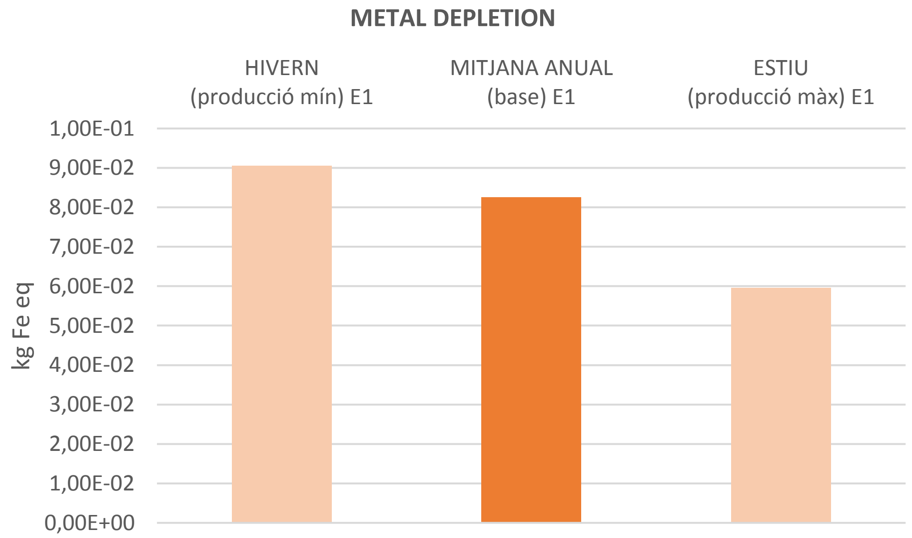
Impact category	Particulate Matter Formation	Increase/reduction in comparison with the base scenario	
Unit	**kg PM10 eq**	**%**	**ratio**
HIVERN (producció mín) E1	2,53E-03	-21,82%	0,78
MITJANA ANUAL (base) E1	3,23E-03	-	
ESTIU (producció màx) E1	5,09E-03	57,45%	1,57



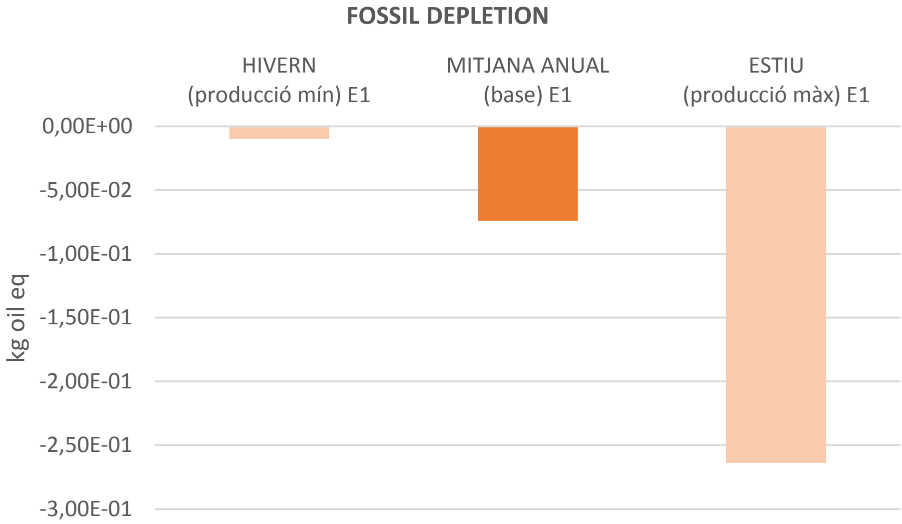
Impact category	Terrestrial Ecotoxicity	Increase/reduction in comparison with the base scenario	
Unit	**kg 1,4-DB eq**	**%**	**ratio**
HIVERN (producció mín) E1	8,91E-04	-50,92%	0,49
MITJANA ANUAL (base) E1	1,81E-03	-	
ESTIU (producció màx) E1	4,35E-03	139,88%	2,40



Impact category	Metal Depletion	Increase/reduction in comparison with the base scenario	
Unit	**kg Fe eq**	**%**	**ratio**
HIVERN (producció mín) E1	9,05E-02	9,69%	1,10
MITJANA ANUAL (base) E1	8,25E-02	-	
ESTIU (producció màx) E1	5,96E-02	-27,75%	0,72

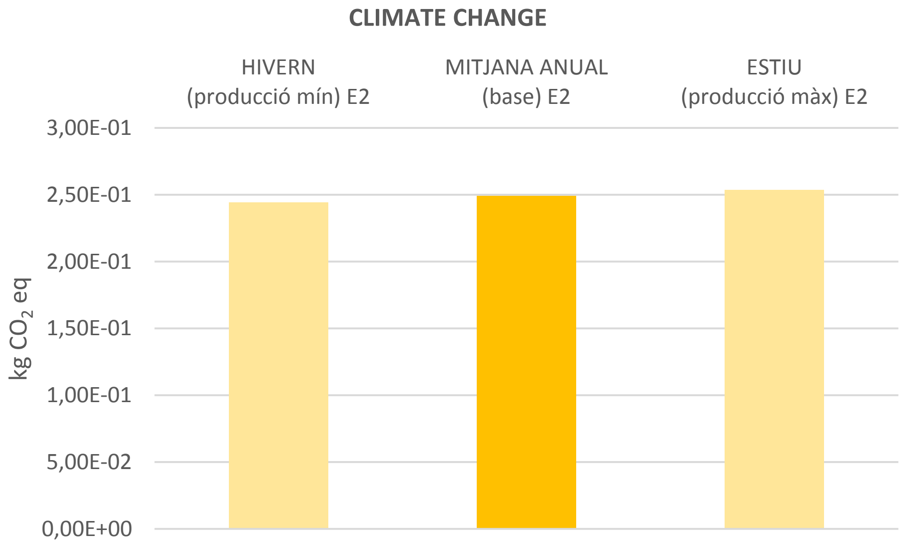


Impact category	Fossil Depletion	Increase/reduction in comparison with the base scenario	
Unit	kg oil eq	%	ratio
HIVERN (producció mín) E1	-9,99E-03	-86,51%	0,13
MITJANA ANUAL (base) E1	-7,41E-02	-	
ESTIU (producció màx) E1	-2,64E-01	256,23%	3,56

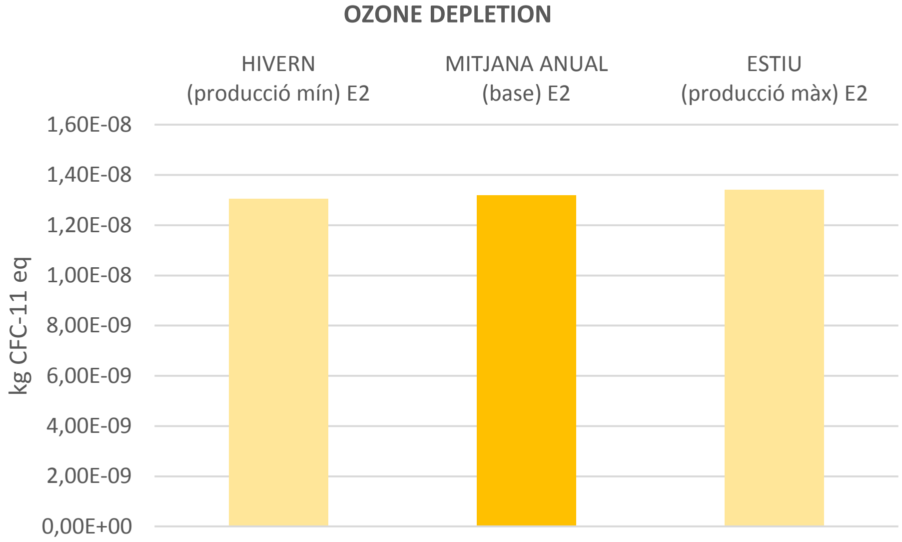


4.2. ESCENARI 2

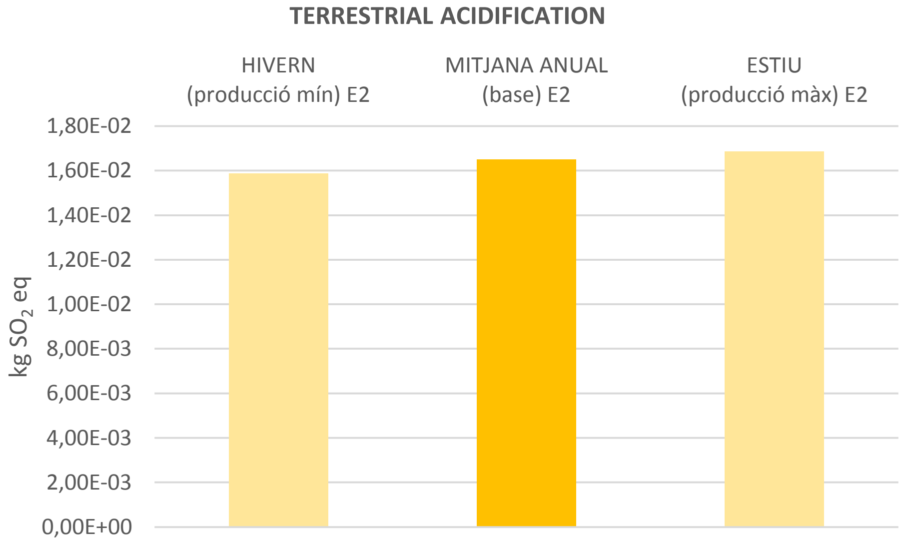
Impact category	Climate Change	Increase/reduction in comparison with the base scenario	
Unit	kg CO_2 eq	%	ratio
HIVERN (producció mín) E2	2,44E-01	-2,01%	0,98
MITJANA ANUAL (base) E2	2,49E-01	-	
ESTIU (producció màx) E2	2,54E-01	1,81%	1,02



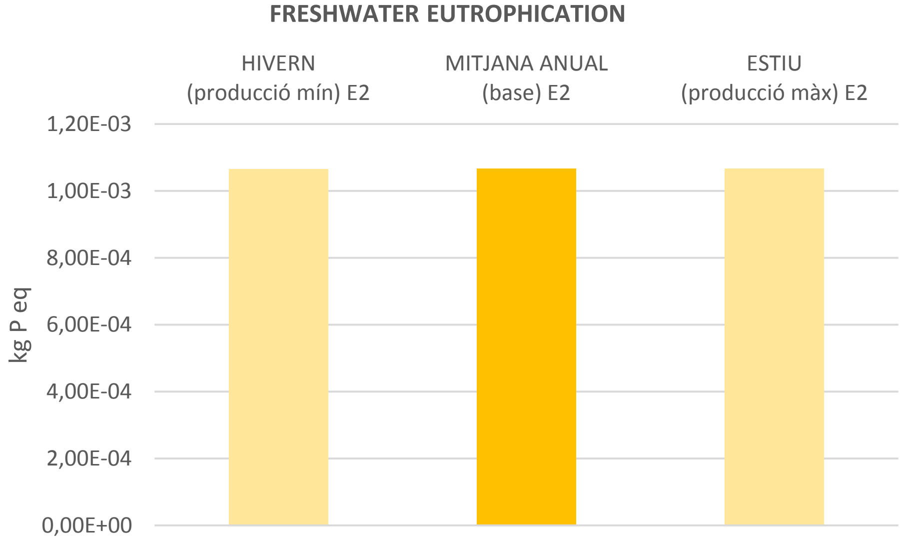
Impact category	Ozone Depletion	Increase/reduction in comparison with the base scenario	
Unit	kg CFC-11 eq	%	ratio
HIVERN (producció mín) E2	1,30E-08	-1,16%	0,99
MITJANA ANUAL (base) E2	1,32E-08	-	
ESTIU (producció màx) E2	1,34E-08	1,62%	1,02



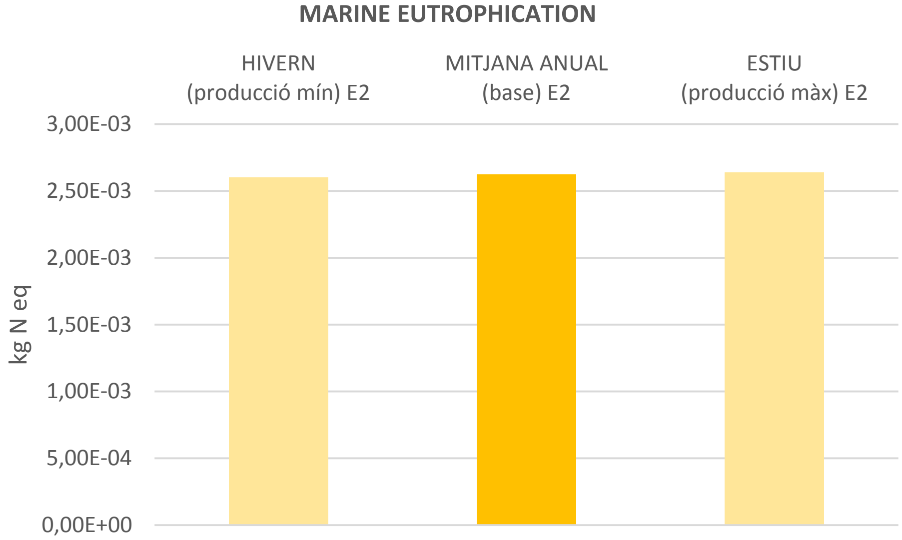
Impact category	Terrestrial Acidification	Increase/reduction in comparison with the base scenario	
Unit	kg SO_2 eq	%	ratio
HIVERN (producció mín) E2	1,59E-02	-3,86%	0,96
MITJANA ANUAL (base) E2	1,65E-02	-	
ESTIU (producció màx) E2	1,69E-02	2,10%	1,02



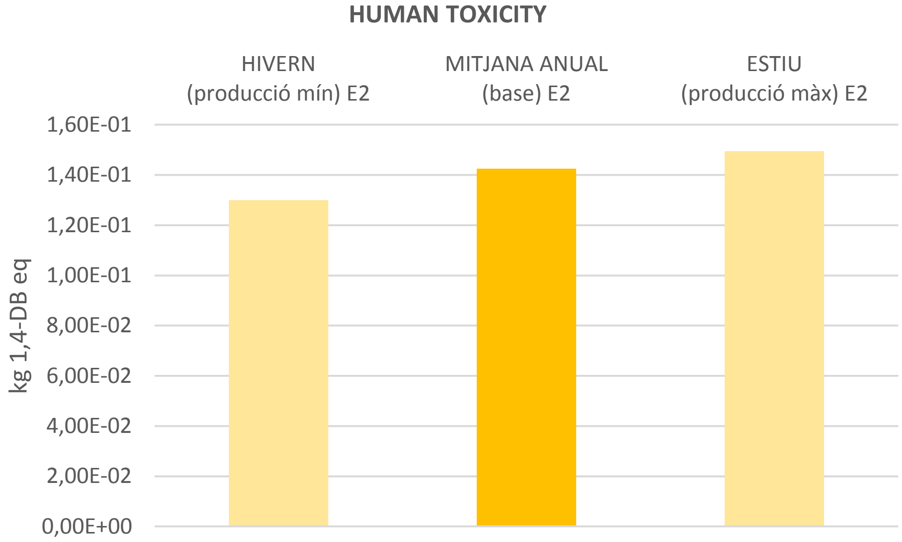
Impact category	Freshwater Eutrophication	Increase/reduction in comparison with the base scenario	
Unit	kg P eq	%	ratio
HIVERN (producció mín) E2	1,07E-03	-0,09%	1,00
MITJANA ANUAL (base) E2	1,07E-03	-	
ESTIU (producció màx) E2	1,07E-03	0,08%	1,00



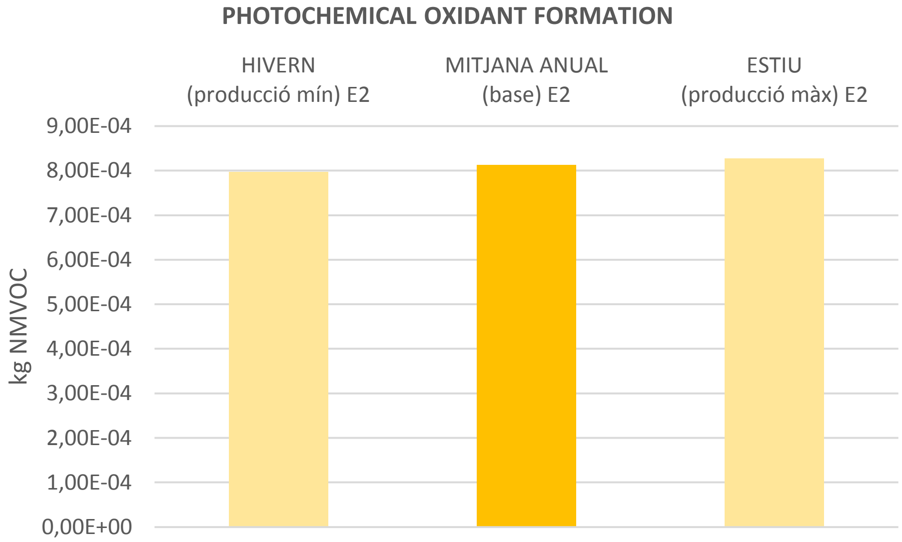
Impact category	Marine Eutrophication	Increase/reduction in comparison with the base scenario	
Unit	kg N eq	%	ratio
HIVERN (producció mín) E2	2,60E-03	-0,89%	0,99
MITJANA ANUAL (base) E2	2,62E-03	-	
ESTIU (producció màx) E2	2,64E-03	0,49%	1,00



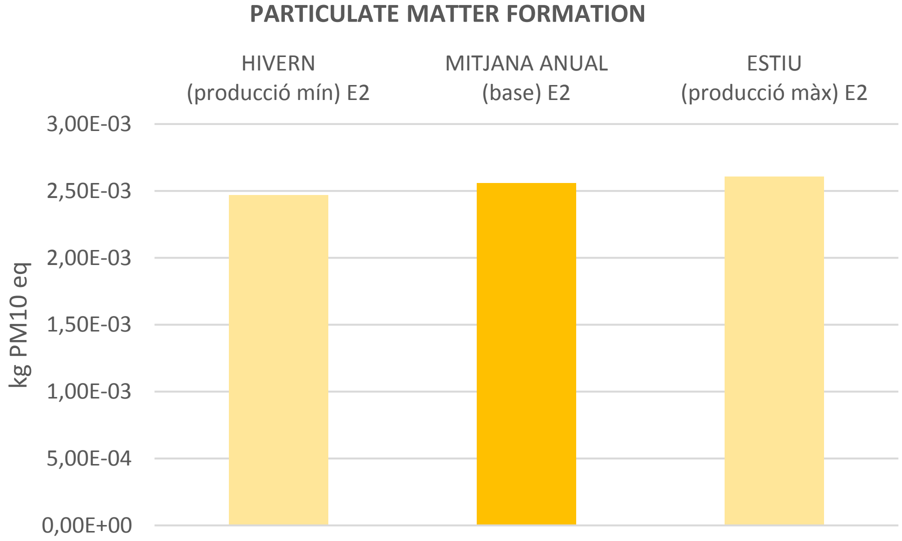
Impact category	Human Toxicity	Increase/reduction in comparison with the base scenario	
Unit	kg 1,4-DB eq	%	ratio
HIVERN (producció mín) E2	1,30E-01	-8,79%	0,91
MITJANA ANUAL (base) E2	1,42E-01	-	
ESTIU (producció màx) E2	1,49E-01	4,94%	1,05



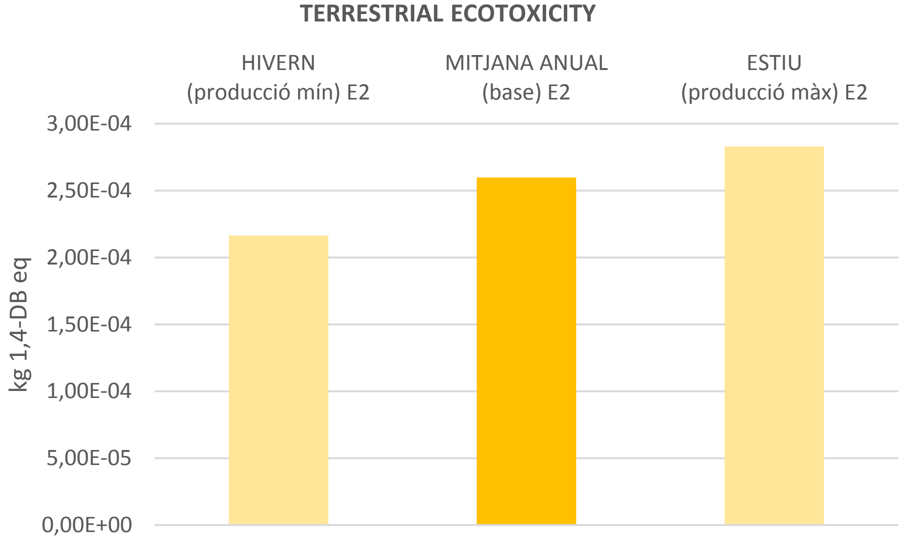
Impact category	Photochemical Oxidant Formation	Increase/reduction in comparison with the base scenario	
Unit	kg NMVOC	%	ratio
HIVERN (producció mín) E2	7,97E-04	-1,92%	0,98
MITJANA ANUAL (base) E2	8,12E-04	-	
ESTIU (producció màx) E2	8,27E-04	1,87%	1,02



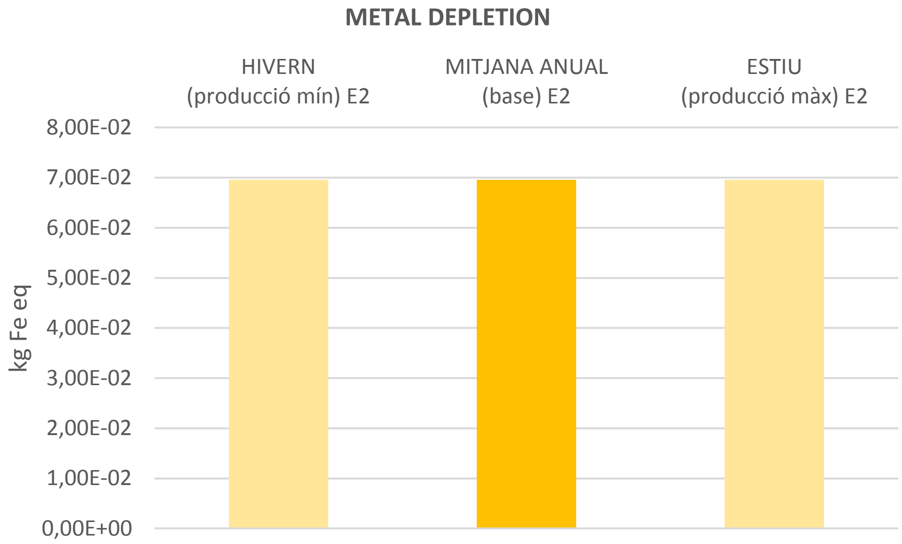
Impact category	Particulate Matter Formation	Increase/reduction in comparison with the base scenario	
Unit	**kg PM10 eq**	**%**	**ratio**
HIVERN (producció mín) E2	2,47E-03	-3,38%	0,97
MITJANA ANUAL (base) E2	2,56E-03	-	
ESTIU (producció màx) E2	2,61E-03	1,92%	1,02



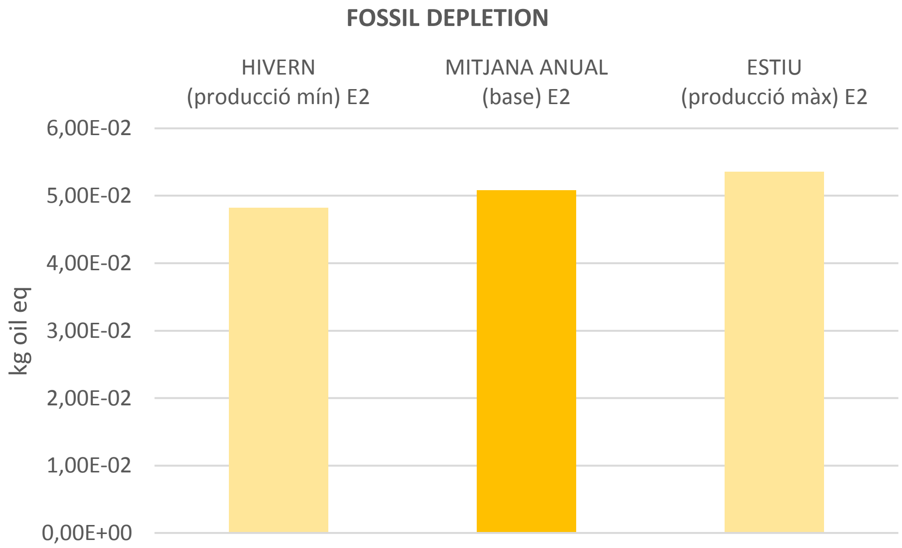
Impact category	Terrestrial Ecotoxicity	Increase/reduction in comparison with the base scenario	
Unit	**kg 1,4-DB eq**	**%**	**ratio**
HIVERN (producció mín) E2	2,17E-04	-16,66%	0,83
MITJANA ANUAL (base) E2	2,60E-04	-	
ESTIU (producció màx) E2	2,83E-04	8,94%	1,09



Impact category	Metal Depletion	Increase/reduction in comparison with the base scenario	
Unit	kg Fe eq	%	ratio
HIVERN (producció mín) E2	6,96E-02	0,13%	1,00
MITJANA ANUAL (base) E2	6,95E-02	-	
ESTIU (producció màx) E2	6,95E-02	0,01%	1,00

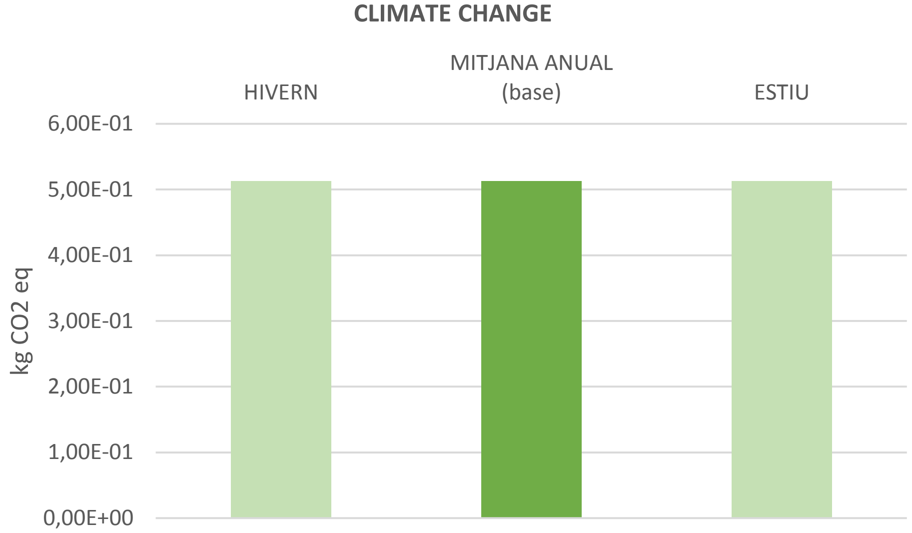


Impact category	Fossil Depletion	Increase/reduction in comparison with the base scenario	
Unit	kg oil eq	%	ratio
HIVERN (producció mín) E2	4,82E-02	-5,30%	0,95
MITJANA ANUAL (base) E2	5,08E-02	-	
ESTIU (producció màx) E2	5,35E-02	5,28%	1,05

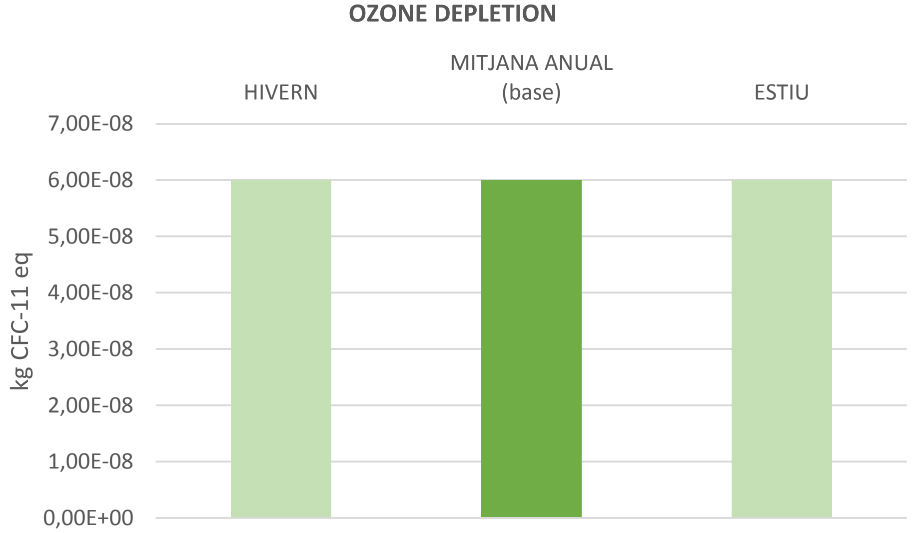


4.3. ESCENARI 3

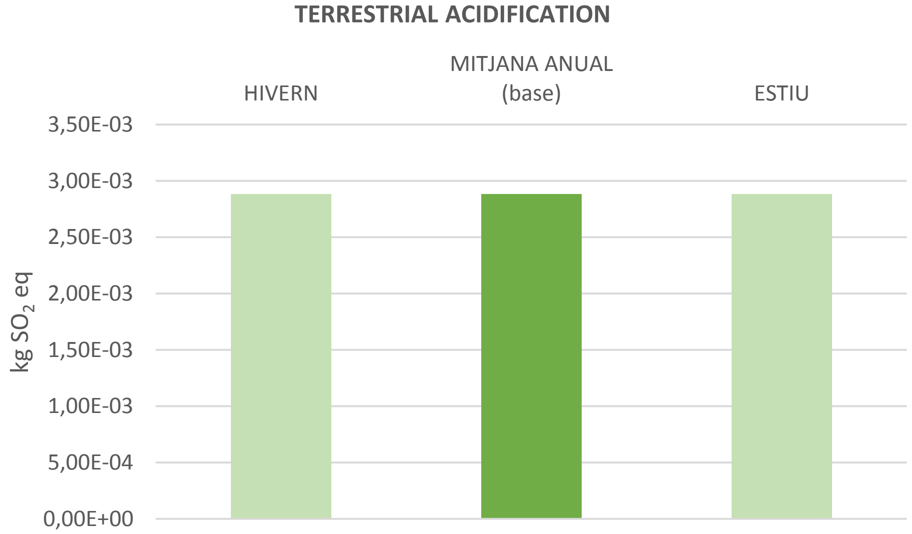
Impact category	Climate Change	Increase/reduction in comparison with the base scenario	
Unit	kg CO2 eq	%	ratio
HIVERN	5,13E-01	0,00%	1,00
MITJANA ANUAL (base)	5,13E-01	-	
ESTIU	5,13E-01	0,00%	1,00



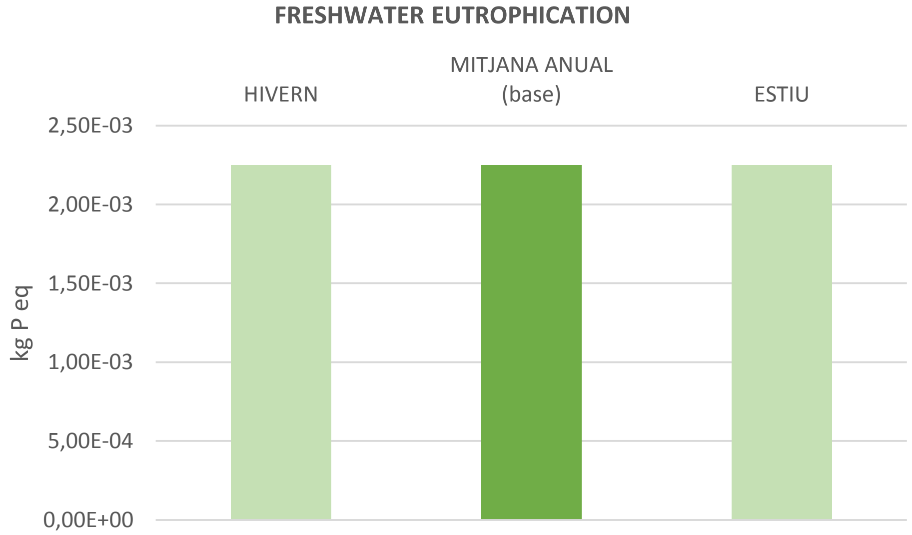
Impact category	Ozone Depletion	Increase/reduction in comparison with the base scenario	
Unit	kg CFC-11 eq	%	ratio
HIVERN	6,00E-08	0,00%	1,00
MITJANA ANUAL (base)	6,00E-08	-	
ESTIU	6,00E-08	0,00%	1,00



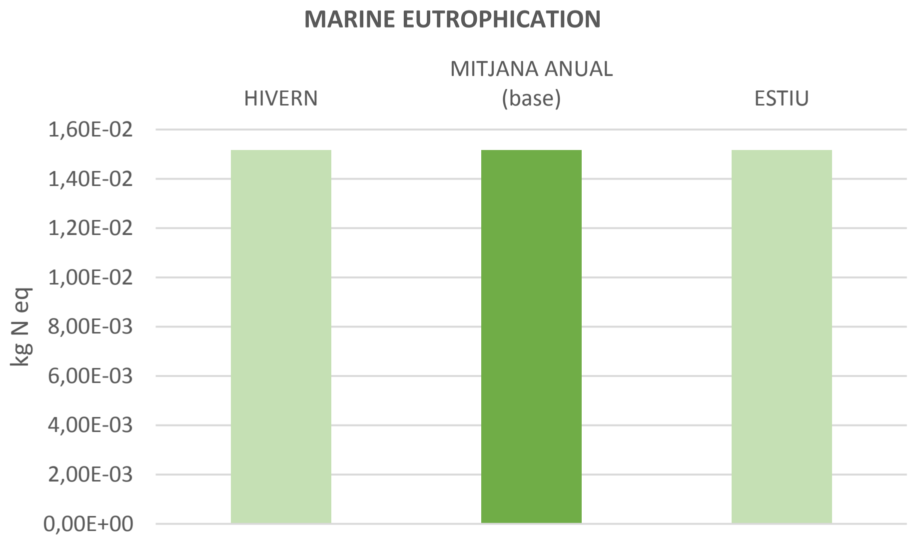
Impact category	Terrestrial Acidification	Increase/reduction in comparison with the base scenario	
Unit	**kg SO_2 eq**	**%**	**ratio**
HIVERN	2,88E-03	0,00%	1,00
MITJANA ANUAL (base)	2,88E-03	-	
ESTIU	2,88E-03	0,00%	1,00



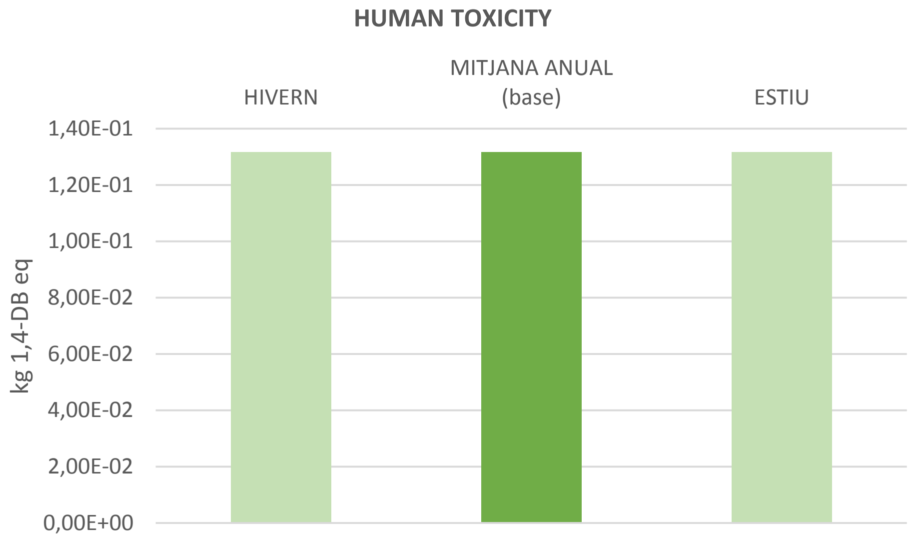
Impact category	Freshwater Eutrophication	Increase/reduction in comparison with the base scenario	
Unit	**kg P eq**	**%**	**ratio**
HIVERN	2,25E-03	0,00%	1,00
MITJANA ANUAL (base)	2,25E-03	-	
ESTIU	2,25E-03	0,00%	1,00



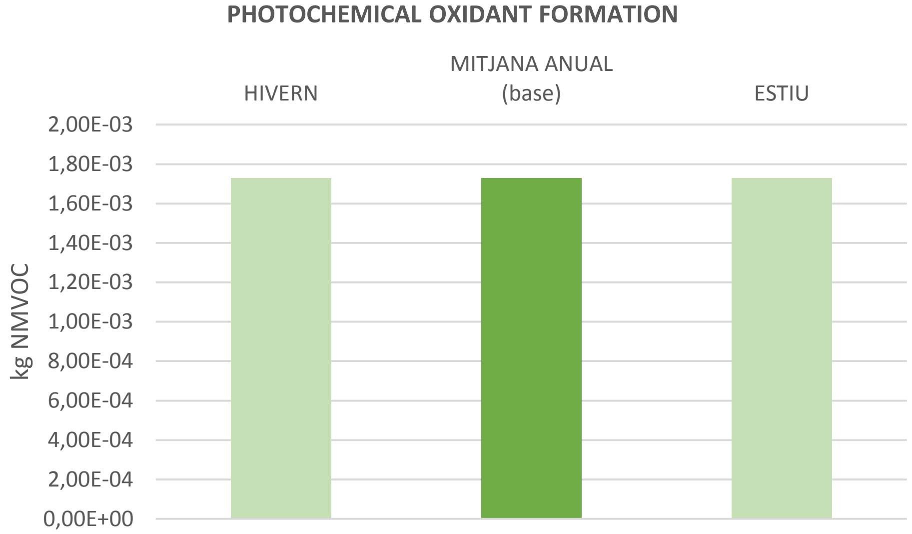
Impact category	Marine Eutrophication	Increase/reduction in comparison with the base scenario	
Unit	**kg N eq**	**%**	**ratio**
HIVERN	1,52E-02	0,00%	1,00
MITJANA ANUAL (base)	1,52E-02	-	
ESTIU	1,52E-02	0,00%	1,00



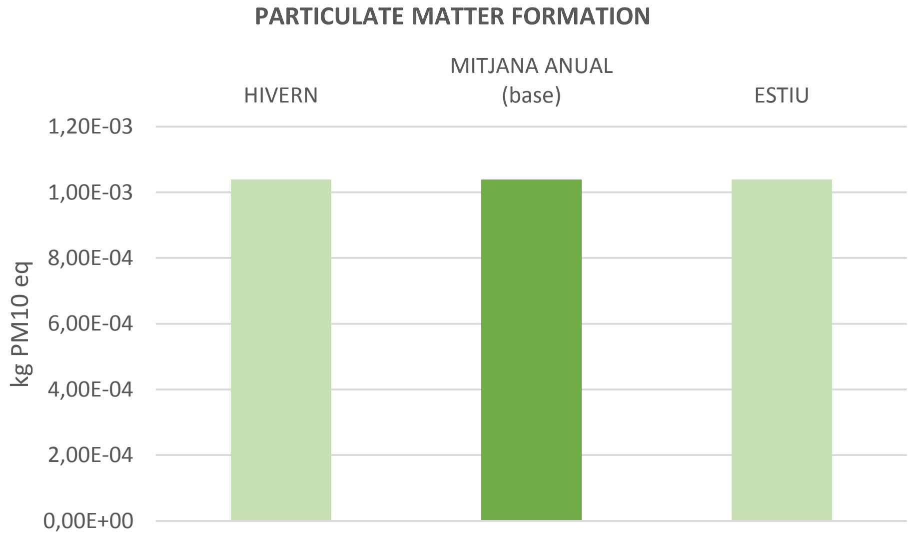
Impact category	Human Toxicity	Increase/reduction in comparison with the base scenario	
Unit	**kg 1,4-DB eq**	**%**	**ratio**
HIVERN	1,32E-01	0,00%	1,00
MITJANA ANUAL (base)	1,32E-01	-	
ESTIU	1,32E-01	0,00%	1,00



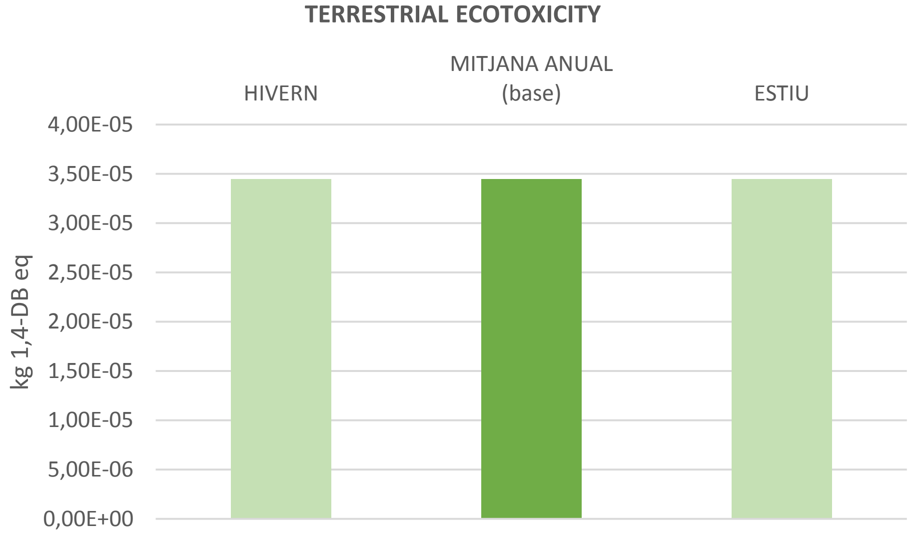
Impact category	Photochemical Oxidant Formation	Increase/reduction in comparison with the base scenario	
Unit	**kg NMVOC**	**%**	**ratio**
HIVERN	1,73E-03	0,00%	1,00
MITJANA ANUAL (base)	1,73E-03	-	
ESTIU	1,73E-03	0,00%	1,00



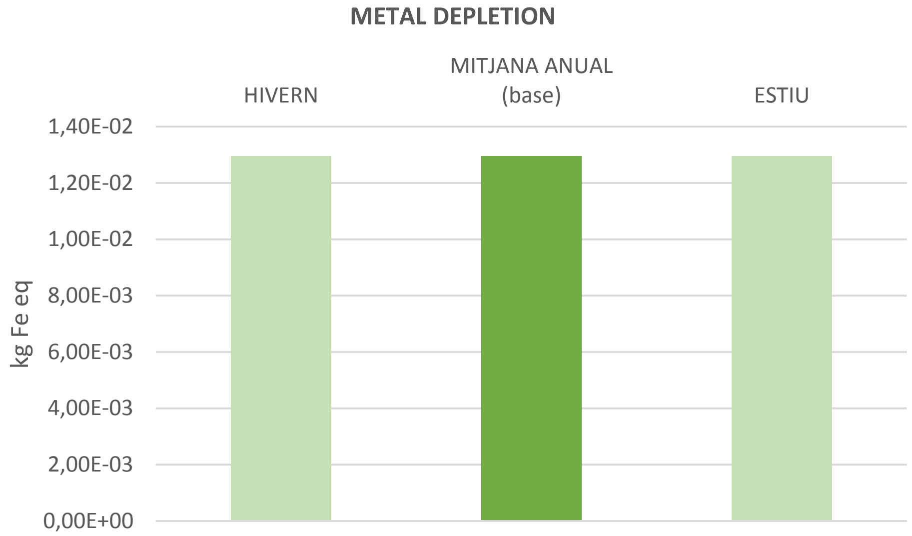
Impact category	Particulate Matter Formation	Increase/reduction in comparison with the base scenario	
Unit	**kg PM10 eq**	**%**	**ratio**
HIVERN	1,04E-03	0,00%	1,00
MITJANA ANUAL (base)	1,04E-03	-	
ESTIU	1,04E-03	0,00%	1,00



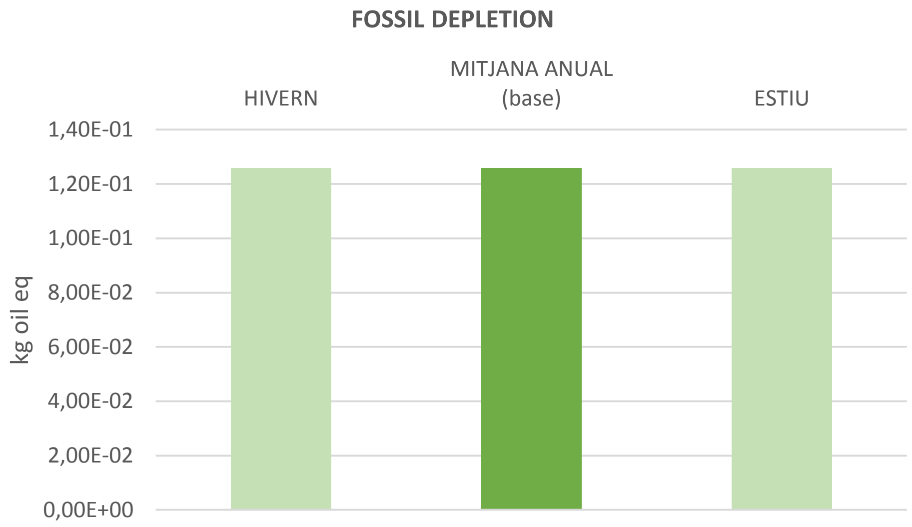
Impact category	Terrestrial Ecotoxicity	Increase/reduction in comparison with the base scenario	
Unit	**kg 1,4-DB eq**	**%**	**ratio**
HIVERN	3,45E-05	0,00%	1,00
MITJANA ANUAL (base)	3,45E-05	-	
ESTIU	3,45E-05	0,00%	1,00



Impact category	Metal Depletion	Increase/reduction in comparison with the base scenario	
Unit	**kg Fe eq**	**%**	**ratio**
HIVERN	1,30E-02	0,00%	1,00
MITJANA ANUAL (base)	1,30E-02	-	
ESTIU	1,30E-02	0,00%	1,00



Impact category	Fossil Depletion	Increase/reduction in comparison with the base scenario	
Unit	**kg oil eq**	**%**	**ratio**
HIVERN	1,26E-01	0,00%	1,00
MITJANA ANUAL (base)	1,26E-01	-	
ESTIU	1,26E-01	0,00%	1,00



ANNEX 3.

TREBALLS DE L’ANÀLISI ECONÒMICA

A. COSTOS DE CONSTRUCCIÓ

PRESSUPOST CONSTRUCCIÓ - ESCENARI 1

PRESSUPOST

Obra 01 Pressupost 01
Capítol 01 Ocupació del terreny

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E22113C2	m2	**Neteja+esbrossada terreny,retro.,+càrr.mec.s/camió** Neteja i esbrossada del terreny realitzada amb retroexcavadora i càrrega mecànica sobre camió (P - 1)	1,99	39.000,000	77.610,00

TOTAL Capítol 01.01 77.610,00

Obra 01 Pressupost 01
Capítol 02 Decantador primari

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 2)	104,65	36,240	3.792,52
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 3)	1,42	2.899,020	4.116,61

TOTAL Capítol 01.02 7.909,13

Obra 01 Pressupost 01
Capítol 03 HRAP

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 2)	104,65	8.459,600	885.297,14
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 3)	1,42	676.768,000	961.010,56

TOTAL Capítol 01.03 1.846.307,70

Obra 01 Pressupost 01
Capítol 04 Decantador secundari

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 2)	104,65	39,200	4.102,28
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 3)	1,42	3.136,170	4.453,36

TOTAL Capítol 01.04 8.555,64

Obra 01 Pressupost 01
Capítol 05 Espessidor

PRESSUPOST

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 2)	104,65	2,530	264,76
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 3)	1,42	202,630	287,73

TOTAL Capítol 01.05 **552,49**

Obra 01 Pressupost 01

Capítol 06 Pretractament tèrmic

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 2)	104,65	3,940	412,32
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 3)	1,42	315,390	447,85

TOTAL Capítol 01.06 **860,17**

Obra 01 Pressupost 01

Capítol 07 Digestor anaeròbic

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 2)	104,65	139,300	14.577,75
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 3)	1,42	11.144,050	15.824,55

TOTAL Capítol 01.07 **30.402,30**

RESUM DE PRESSUPOST

			Import
Capítol	01.01	Ocupació del terreny	77.610,00
Capítol	01.02	Decantador primari	7.909,13
Capítol	01.03	HRAP	1.846.307,70
Capítol	01.04	Decantador secundari	8.555,64
Capítol	01.05	Espessidor	552,49
Capítol	01.06	Pretractament tèrmic	860,17
Capítol	01.07	Digestor anaeròbic	30.402,30
Obra	**01**	**Pressupost 01**	**1.972.197,43**

PRESSUPOST CONSTRUCCIÓ - ESCENARI 2

PRESSUPOST

Obra	01	Pressupost 02
Capítol	01	Ocupació del terreny

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E22113C2	m2	**Neteja+esbrossada terreny,retro.,+càrr.mec.s/camió** Neteja i esbrossada del terreny realitzada amb retroexcavadora i càrrega mecànica sobre camió (P - 2)	1,99	29.250,000	58.207,50
TOTAL	**Capítol**		**01.01**			**58.207,50**

Obra	01	Pressupost 02
Capítol	02	HRAP

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 3)	104,65	6.145,380	643.114,02
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 4)	1,42	491.630,400	698.115,17
TOTAL	**Capítol**		**01.02**			**1.341.229,19**

Obra	01	Pressupost 02
Capítol	03	Decantador secundari

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	E45219G3	m3	**Formigó p/mur, HA-30/P/20/IIb,cubilot** Formigó per a mur, HA-30/P/20/IIb, de consistència plàstica i grandària màxima del granulat 20 mm, abocat amb cubilot (P - 3)	104,65	39,200	4.102,28
2	E4B23000	kg	**Armadura p/mur AP500S barres corrug.** Armadura per a mur AP500 S d'acer en barres corrugades B500S de límit elàstic >= 500 N/mm2 (P - 4)	1,42	3.136,170	4.453,36
TOTAL	**Capítol**		**01.03**			**8.555,64**

Obra	01	Pressupost 02
Capítol	04	Centrífuga

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	04001NMV	u	**Centrífuga** Centríguda (P - 1)	10.000,00	1,000	10.000,00
TOTAL	**Capítol**		**01.04**			**10.000,00**

RESUM DE PRESSUPOST

			Import
Capítol	01.01	Ocupació del terreny	58.207,50
Capítol	01.02	HRAP	1.341.229,19
Capítol	01.03	Decantador secundari	8.555,64
Capítol	01.04	Centrífuga	10.000,00
Obra	**01**	**Pressupost 02**	**1.417.992,33**

B. COSTOS D’EXPLOTACIÓ

PRESSUPOST EXPLOTACIÓ - ESCENARI 1

PRESSUPOST

Obra	01	Pressupost 01
Capítol	01	Consum energètic

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	09001NMV	kWh	**Electricitat decantador primari** Electricitat decantador primari (P - 1)	0,14	8,609	1,21
2	09002NMV	kWh	**Electricitat HRAP** Electricitat HRAP (P - 2)	0,14	22,082	3,09
3	09003NMV	kWh	**Electricitat decantador secundari (bomba)** Electricitat decantador secundari (bomba) (P - 3)	0,14	4,674	0,65
4	09004NMV	kWh	**Electricitat decantador secundari (recirculació)** Electricitat decantador secundari (recirculació) (P - 4)	0,14	0,231	0,03
5	09005NMV	kWh	**Calor digestor anaeròbic (inclou pretractament tèrmic)** Calor pretractament (P - 5)	0,05	755,031	37,75
6	09006NMV	kWh	**Electricitat digestor anaeròbic** Electricitat difestor anaeròbic (P - 6)	0,14	81,248	11,37

TOTAL Capítol 01.01 54,10

RESUM DE PRESSUPOST

NIVELL 2: Capítol			Import
Capítol	01.01	Consum energètic	54,10
Obra	**01**	**Pressupost 01**	**54,10**

PRESSUPOST EXPLOTACIÓ - ESCENARI 2

PRESSUPOST

Obra 01 Pressupost 02

Capítol 01 Consum energètic

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	06001NMV	kWh	**Electricitat HRAP** Electricitat HRAP (P - 1)	0,14	21,549	3,02
2	06002NMV	kWh	**Electricitat decantador secundari** Electricitat decantador secundari (P - 2)	0,14	11,256	1,58
3	06003NMV	kWh	**Electricitat centrífuga** Electricitat centrífuga (P - 3)	0,14	22,512	3,15
4	06004NMV	kWh	**Calor producció biofertilitzant** Calor producció biofertilitzant (P - 4)	0,05	52,696	2,63
5	06005NMV	kWh	**Electricitat producció biofertilitzant** Electricitat producció biofertilitzant (P - 5)	0,14	39,000	5,46

TOTAL Capítol 01.01 15,84

Obra 01 Pressupost 02

Capítol 02 Addició de productes químics

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	07001NMV	kg	**Floculant** Floculant (P - 6)	1,00	19,500	19,50

TOTAL Capítol 01.02 19,50

RESUM DE PRESSUPOST

NIVELL 2: Capítol			Import
Capítol	01.01	Consum energètic	15,84
Capítol	01.02	Addició de productes químics	19,50
Obra	**01**	**Pressupost 02**	**35,34**

PRESSUPOST EXPLOTACIÓ - ESCENARI 1 HIVERN

PRESSUPOST

Obra	01	Pressupost 01 HIVERN
Capítol	01	Consum energètic

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	09001NMV	kWh	**Electricitat decantador primari** Electricitat decantador primari (P - 1)	0,14	4,165	0,58
2	09002NMV	kWh	**Electricitat HRAP** Electricitat HRAP (P - 2)	0,14	22,082	3,09
3	09003NMV	kWh	**Electricitat decantador secundari (bomba)** Electricitat decantador secundari (bomba) (P - 3)	0,14	2,261	0,32
4	09004NMV	kWh	**Electricitat decantador secundari (recirculació)** Electricitat decantador secundari (recirculació) (P - 4)	0,14	0,161	0,02
5	09005NMV	kWh	**Calor digestor anaeròbic (inclou pretractament tèrmic)** Calor pretractament (P - 5)	0,05	371,858	18,59
6	09006NMV	kWh	**Electricitat digestor anaeròbic** Electricitat difestor anaeròbic (P - 6)	0,14	19,601	2,74

TOTAL	**Capítol**	**01.01**	**25,34**

RESUM DE PRESSUPOST

NIVELL 2: Capítol			Import
Capítol	01.01	Consum energètic	25,34
Obra	**01**	**Pressupost 01 HIVERN**	**25,34**

PRESSUPOST EXPLOTACIÓ - ESCENARI 2 HIVERN

PRESSUPOST

Obra	01	Pressupost 02	
Capítol	01	Consum energètic	

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	06001NMV	kWh	**Electricitat HRAP** Electricitat HRAP (P - 1)	0,14	21,549	3,02
2	06002NMV	kWh	**Electricitat decantador secundari** Electricitat decantador secundari (P - 2)	0,14	9,241	1,29
3	06003NMV	kWh	**Electricitat centrífuga** Electricitat centrífuga (P - 3)	0,14	18,482	2,59
4	06004NMV	kWh	**Calor producció biofertilitzant** Calor producció biofertilitzant (P - 4)	0,05	43,263	2,16
5	06005NMV	kWh	**Electricitat producció biofertilitzant** Electricitat producció biofertilitzant (P - 5)	0,14	32,018	4,48

TOTAL Capítol 01.01 13,54

Obra	01	Pressupost 02	
Capítol	02	Addició de productes químics	

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	07001NMV	kg	**Floculant** Floculant (P - 6)	1,00	15,600	15,60

TOTAL Capítol 01.02 15,60

RESUM DE PRESSUPOST

NIVELL 2: Capítol			Import
Capítol	01.01	Consum energètic	13,54
Capítol	01.02	Addició de productes químics	15,60
Obra	**01**	**Pressupost 02**	**29,14**

PRESSUPOST EXPLOTACIÓ - ESCENARI 1 ESTIU

PRESSUPOST

Obra 01 Pressupost 01 ESTIU

Capítol 01 Consum energètic

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	09001NMV	kWh	**Electricitat decantador primari** Electricitat decantador primari (P - 1)	0,14	20,826	2,92
2	09002NMV	kWh	**Electricitat HRAP** Electricitat HRAP (P - 2)	0,14	22,082	3,09
3	09003NMV	kWh	**Electricitat decantador secundari (bomba)** Electricitat decantador secundari (bomba) (P - 3)	0,14	11,306	1,58
4	09004NMV	kWh	**Electricitat decantador secundari (recirculació)** Electricitat decantador secundari (recirculació) (P - 4)	0,14	0,806	0,11
5	09005NMV	kWh	**Calor digestor anaeròbic (inclou pretractament tèrmic)** Calor pretractament (P - 5)	0,05	1.724,250	86,21
6	09006NMV	kWh	**Electricitat digestor anaeròbic** Electricitat difestor anaeròbic (P - 6)	0,14	98,005	13,72

TOTAL Capítol 01.01 107,63

RESUM DE PRESSUPOST

NIVELL 2: Capítol			Import
Capítol	01.01	Consum energètic	107,63
Obra	**01**	**Pressupost 01 ESTIU**	**107,63**

PRESSUPOST EXPLOTACIÓ - ESCENARI 2 ESTIU

PRESSUPOST

Obra	01	Pressupost 02
Capítol	01	Consum energètic

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	06001NMV	kWh	**Electricitat HRAP** Electricitat HRAP (P - 1)	0,14	21,549	3,02
2	06002NMV	kWh	**Electricitat decantador secundari** Electricitat decantador secundari (P - 2)	0,14	12,321	1,72
3	06003NMV	kWh	**Electricitat centrífuga** Electricitat centrífuga (P - 3)	0,14	24,643	3,45
4	06004NMV	kWh	**Calor producció biofertilitzant** Calor producció biofertilitzant (P - 4)	0,05	57,684	2,88
5	06005NMV	kWh	**Electricitat producció biofertilitzant** Electricitat producció biofertilitzant (P - 5)	0,14	42,690	5,98

TOTAL Capítol 01.01 17,05

Obra	01	Pressupost 02
Capítol	02	Addició de productes químics

NUM.	CODI	UA	DESCRIPCIÓ	PREU	AMIDAMENT	IMPORT
1	07001NMV	kg	**Floculant** Floculant (P - 6)	1,00	23,400	23,40

TOTAL Capítol 01.02 23,40

RESUM DE PRESSUPOST

NIVELL 2: Capítol			Import
Capítol	01.01	Consum energètic	17,05
Capítol	01.02	Addició de productes químics	23,40
Obra	**01**	**Pressupost 02**	**40,45**

ANNEX 4.

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Life cycle assessment of high rate algal ponds for wastewater treatment and resource recovery

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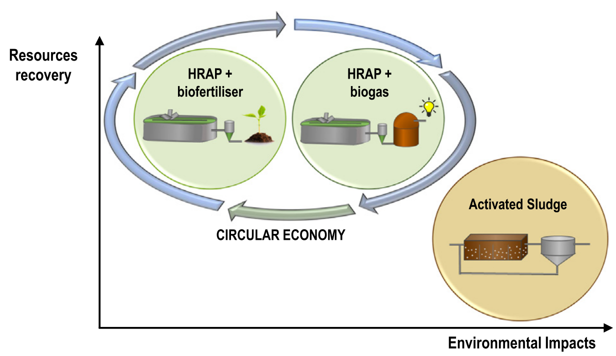
HIGHLIGHTS

- LCA of HRAP systems coupled with biogas and biofertilizer production was carried out.
- Environmental impacts of HRAP systems were compared to activated sludge system.
- HRAPs showed similar environmental performance if compared to activated sludge system.
- Climatic conditions and algae biomass characteristics strongly influence LCA results.

GRAPHICAL ABSTRACT



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ABSTRACT

The aim of this study was to assess the potential environmental impacts associated with high rate algal ponds (HRAP) systems for wastewater treatment and resource recovery in small communities. To this aim, a Life Cycle Assessment (LCA) was carried out evaluating two alternatives: i) a HRAP system for wastewater treatment where microalgal biomass is valorized for energy recovery (biogas production); ii) a HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production). Additionally, both alternatives were compared to a typical small-sized activated sludge system. An economic assessment was also performed. The results showed that HRAP system coupled with biogas production appeared to be more environmentally friendly than HRAP system coupled with biofertilizer production in the climate change, ozone layer depletion, photochemical oxidant formation, and fossil depletion impact categories. Different climatic conditions have strongly influenced the results obtained in the eutrophication and metal depletion impact categories. In fact, the HRAP system located where warm temperatures and high solar radiation are predominant (HRAP system coupled with biofertilizer production) showed lower impact in those categories. Additionally, the characteristics (e.g. nutrients and heavy metals concentration) of microalgal biomass recovered from wastewater appeared to be crucial when assessing the potential environmental impacts in the terrestrial acidification, particulate matter formation and toxicity impact categories. In terms of costs, HRAP systems seemed to be more economically feasible when combined with biofertilizer production instead of biogas. On the whole, implementing HRAPs instead of activated sludge systems might increase sustainability and cost-effectiveness

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of wastewater treatment in small communities, especially if implemented in warm climate regions and coupled with biofertilizer production.

1. Introduction

High rate algal ponds (HRAPs) for wastewater treatment were introduced around 50 years ago and used since then not only to grow microalgae biomass but also to treat a wide variety of municipal and industrial wastewaters (Craggs et al., 2014; Oswald and Golueke, 1960). These systems are shallow, paddlewheel mixed, raceway ponds where microalgae assimilate nutrients and produce oxygen, which is used by heterotrophic bacteria to oxidise organic matter improving water quality (Craggs et al., 2014; Park et al., 2011). Since mechanical aeration is not required, energy consumption in these systems is much lower compared to a conventional wastewater treatment plant (e.g. activated sludge system) (around 0.02 kWh m^{-3} of water vs. 1 kWh m^{-3} of water, respectively) (Garfí et al., 2017; Passos et al., 2017). Moreover, HRAPs are less expensive and require little maintenance compared to conventional systems (Craggs et al., 2014; Garfí et al., 2017; Molinos-Senante et al., 2014). Due to their low cost and low energy consumption, HRAP systems could have a wide range of applications in Mediterranean regions, which present suitable climatic conditions for microalgae growth (e.g. high solar radiation). However, to achieve a satisfactory performance, large land area is required compared to conventional systems (around 6 m^2 p.e.$^{-1}$ vs. 0.5 m^2 p.e.$^{-1}$ for HRAP and activated sludge systems, respectively), making them more suitable for small communities (up to 10,000 p.e.).

Nowadays, there is an important need to shift the paradigm from wastewater treatment to resource recovery to alleviate negative effects associated with human activities, such as pollution of water bodies, greenhouse gas (GHG) emissions and scarcity of mineral resources. In this context, microalgae grown in HRAPs can be harvested and reused to produce biofuels or other non-food bioproducts. In particular, intensive research has been developed during the last years to investigate the potential of microalgae to produce biofuels such as biogas. Indeed, the biogas produced from microalgal biomass was found to contain high energy value, making microalgae anaerobic digestion an attractive alternative for biofuel production (Chew et al., 2017; Jankowska et al., 2017; Montingelli et al., 2015; Uggetti et al., 2017). On the other hand, microalgae also offer the potential to recover nutrients from wastewater and, subsequently, to be applied as a sustainable fertilizer. During the last decade, this alternative has been described by several authors, considering the fact that microalgae contain high amounts of proteins rich in essential amino acids, as well as phytohormones that stimulate plant growth (Coppens et al., 2016; García-Gonzalez and Sommerfeld, 2016; Jäger et al., 2010; Uysal et al., 2015).

Recent studies have employed the Life Cycle Assessment (LCA) methodology to assess the environmental impact of HRAP systems for wastewater treatment. They demonstrated that HRAPs might help to reduce environmental impacts and costs associated with wastewater treatment compared to conventional systems (e.g. activated sludge system), especially in small communities (Garfí et al., 2017; Maga, 2016). These studies also highlighted that the LCA methodology is an appropriate tool to support early-stage research and development of novel technologies and processes (Fang et al., 2016; Garfí et al., 2017). Indeed, LCA methodology takes into account and quantifies all environmental exchanges (i.e. resources, energy, emissions, waste) occurring during all stages of the technology life cycle (Ferreira et al., 2014; Ferreira et al., 2017; ISO, 2000).

Nevertheless, to the best of the authors' knowledge, there are no studies assessing the environmental impacts of HRAP system for wastewater treatment considering different configurations for resource and energy recovery.

The objective of this work was to evaluate the potential environmental impacts associated with HRAP systems for wastewater treatment taking into account two resource recovery strategies. To this aim a LCA was carried out comparing the following alternatives: (i) a HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production); (ii) a HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production). For the sake of comparison, both scenarios were compared to a typical small-sized activated sludge system. Additionally, an economic evaluation was addressed in order to assess the feasibility of the HRAP alternatives based on the costs and benefits related to each of them.

This paper is organized as follows: Section 2 describes the wastewater treatment systems, as well as the methodology used for the LCA and the economic analysis; in Section 3 the results of the comparative LCA and the economic analysis are described; finally, in Section 4 the main conclusions are highlighted.

2. Material and methods

2.1. Wastewater treatment systems description

The HRAP systems were hypothetical wastewater treatment plants based on extrapolation from lab-scale and pilot-scale studies (up to 100 m^2). The systems were designed to serve a population equivalent of 10,000 p.e. and treat a flow rate of 1950 m^3 d^{-1}. The HRAP system coupled with biogas production was considered to be implemented in Catalonia (Barcelona, Spain), where the mean temperature and global solar radiation are 15.5 °C and 4.56 kWh/m^2 d, respectively (AEMET, 2017). For this case study, the design parameters were calculated taking into account the experimental results obtained in lab-scale and pilot systems (up to 5 m^2) located at the Universitat Politècnica de Catalunya-BarcelonaTech (UPC) (Barcelona, Spain) (García et al., 2000; García et al., 2006; Gutiérrez et al., 2016; Passos and Ferrer, 2014; Solé-Bundó et al., 2015; Solé-Bundó et al., 2017). This system comprises a primary settler (Hydraulic Retention Time (HRT) = 2.5 h) followed by four HRAPs (Table 1). From these units, wastewater goes through a secondary settler (HRT = 3 h) where microalgal biomass is harvested and separated from wastewater. Treated water is then discharged into a surface water body. Part of the harvested microalgal biomass (2 and 10% on a dry weight basis in summer and winter, respectively) is recycled in order to enhance spontaneous flocculation (bioflocculation) and increase microalgae harvesting efficiency (Gutiérrez et al., 2016). The remaining harvested biomass is thickened (HRT = 24 h), thermally pretreated (75 °C, 10 h) and co-digested with primary sludge (35 °C, 20 days). The biogas produced is then converted in a combined heat and power (CHP) unit, while the digestate is transported and reused in agriculture. In this context, the HRT of each HRAP has to be modified over the year (8, 6 and 4 days) in accordance with the weather conditions (i.e. solar radiation and temperature) in order to accomplish wastewater treatment and meet effluent quality requirements for discharge (García et al., 2000; Gutiérrez et al., 2016). For this reason, it was considered that during summer months (from May to July) only two HRAPs work in parallel (HRT = 4 days), whereas all of them are operated during winter months (from November to April) (HRT = 8 days). During the rest of the year (from August to October), the HRT is 6 days (3 HRAPs working in parallel).

The HRAP system coupled with biofertilizer production was considered to be implemented in Andalucía (Almeria, Spain), where the mean temperature and global solar radiation are 19.1 °C and 5.29 kWh/m^2 d,

Table 1
Characteristics and design parameters of the HRAP coupled with biogas production (Scenario 1).

System characteristics	Unit			
Inlet BOD_5 concentration	$mg_{BOD}\ L^{-1}$			300
Outlet BOD_5 concentration	$mg_{BOD}\ L^{-1}$			<25
Inlet TSS concentration	$mg_{TSS}\ L^{-1}$			150
Outlet TSS concentration	$mg_{TSS}\ L^{-1}$			<35
Inlet total nitrogen	$mg_{TN}\ L^{-1}$			39
Outlet total nitrogen	$mg_{TN}\ L^{-1}$			9.38
Inlet total phosphorous	$mg_{TP}\ L^{-1}$			5
Outlet total phosphorous	$mg_{TP}\ L^{-1}$			3.69
Flow rate	$m^3\ d^{-1}$			1950
Population equivalent	p.e.			10,000
Total surface area	m^2			40,000
Specific area requirement	$m^2\ p.e.^{-1}$			4
HRAPs design parameters	Unit	Summer	Winter	Rest of the year
OLR	$g_{BOD}\ m^{-2}\ d^{-1}$		10	
HRT	d	4	8	6
Number of ponds	–	2	4	3
Channel width	m	12		
Channel length	m		812.5	
Water depth	m		0.4	
Microalgae biomass production	$g_{TSS}\ m^{-2}\ d^{-1}$	25.8	3.3	10.5
Annual average microalgae biomass production	$g_{TSS}\ m^{-2}\ d^{-1}$		12	

Note: BOD: Biochemical oxygen demand; TSS: Total suspended solids; HRT: Hydraulic Retention Time; OLR: Organic Loading Rate. Summer: from May to July; winter: from November to April.

Table 2
Characteristics and design parameters of the HRAP coupled with biofertilizer production (Scenario 2).

System characteristics	Unit			
Inlet BOD_5 concentration	$mg_{BOD}\ L^{-1}$			300
Outlet BOD_5 concentration	$mg_{BOD}\ L^{-1}$			<25
Inlet TSS concentration	$mg_{TSS}\ L^{-1}$			200
Outlet TSS concentration	$mg_{TSS}\ L^{-1}$			<35
Inlet total nitrogen	$mg_{TN}\ L^{-1}$			50
Outlet total nitrogen	$mg_{TN}\ L^{-1}$			2
Inlet total phosphorous	$mg_{TP}\ L^{-1}$			10
Outlet total phosphorous	$mg_{TP}\ L^{-1}$			1
Flow rate	$m^3\ d^{-1}$			1950
Population equivalent	p.e.			10,000
Total surface area	m^2			30,000
Specific area requirement	$m^2\ p.e.^{-1}$			3
HRAPs design parameters	Unit	Summer	Winter	Rest of the year
OLR	$g_{BOD}\ m^{-2}\ d^{-1}$		20	
HRT	d		3	
Number of ponds	–		2	
Channel width	m		12	
Channel length	m		1219	
Water depth	m		0.2	
Microalgae biomass production	$g_{TSS}\ m^{-2}\ d^{-1}$	30	15	25
Annual average microalgae biomass production	$g_{TSS}\ m^{-2}\ d^{-1}$		23	

Note: BOD: Biochemical oxygen demand; TSS: Total suspended solids; HRT: Hydraulic Retention Time; OLR: Organic Loading Rate. Summer: from May to August; winter: from November to March.

respectively (AEMET, 2017). For this case study, the designed parameters were determined using the results obtained in a pilot system located at the Las Palmerillas Experimental Station (Almeria, Spain) (100 m^2) (Morales-Amaral et al., 2015a). This system consists of two HRAPs operating in parallel and followed by a settler (HRT = 3 h) where microalgal biomass is separated using an organic flocculant (Table 2). From this unit, treated wastewater is discharged into a surface water body, while harvested microalgae biomass is dewatered on-site using a centrifuge and later sold to a local company to produce a biofertilizer (NPK = 5-1-0.75). The biofertilizer produced from the dewatered biomass is then transported and reused in agriculture. In this case, due to the more favourable climatic conditions for microalgae growth compared to Catalonia, the HRT was the same over the year (HRT = 3 days). It has to be noted that, for the same reason, the microalgal biomass production is considerably higher in the system implemented in Andalucía with respect to the one located in Catalonia (3–26 $g_{TSS}\ m^{-2}\ d^{-1}$ vs. 15–30 $g_{TSS}\ m^{-2}\ d^{-1}$, respectively) (Gutiérrez et al., 2016; Morales-Amaral et al., 2015a).

For the sake of comparison, the potential environmental impacts of the HRAP systems were compared to those generated by a conventional small-sized wastewater treatment plant (10,000 p.e.). For that purpose, the design of a usual small-scale activated sludge system implemented in Spain was taken into account (Gallego et al., 2008; Garfí et al., 2017; Lorenzo-Toja et al., 2015). It comprises a primary settler, followed by an activated sludge reactor with extended aeration and a secondary settler (Table 3). Treated water is discharged into the environment and the sludge is conditioned, thickened, centrifuged on-site and then transported to an incineration facility.

Fig. 1 shows the flow diagrams of the treatment alternatives. Tables 1, 2 and 3 show the characteristics and design parameters of the HRAP and activated sludge systems.

2.2. Life cycle assessment

The LCA was conducted following the ISO standards (ISO, 2000; ISO, 2006) in order to evaluate and quantify the potential environmental impact of the investigated scenarios. It consisted of four main stages: i) goal and scope definition, ii) inventory analysis, iii) impacts assessment and iv) interpretation of the results (ISO, 2006). The following sections describe the specific content of each phase.

2.2.1. Goal and scope definition

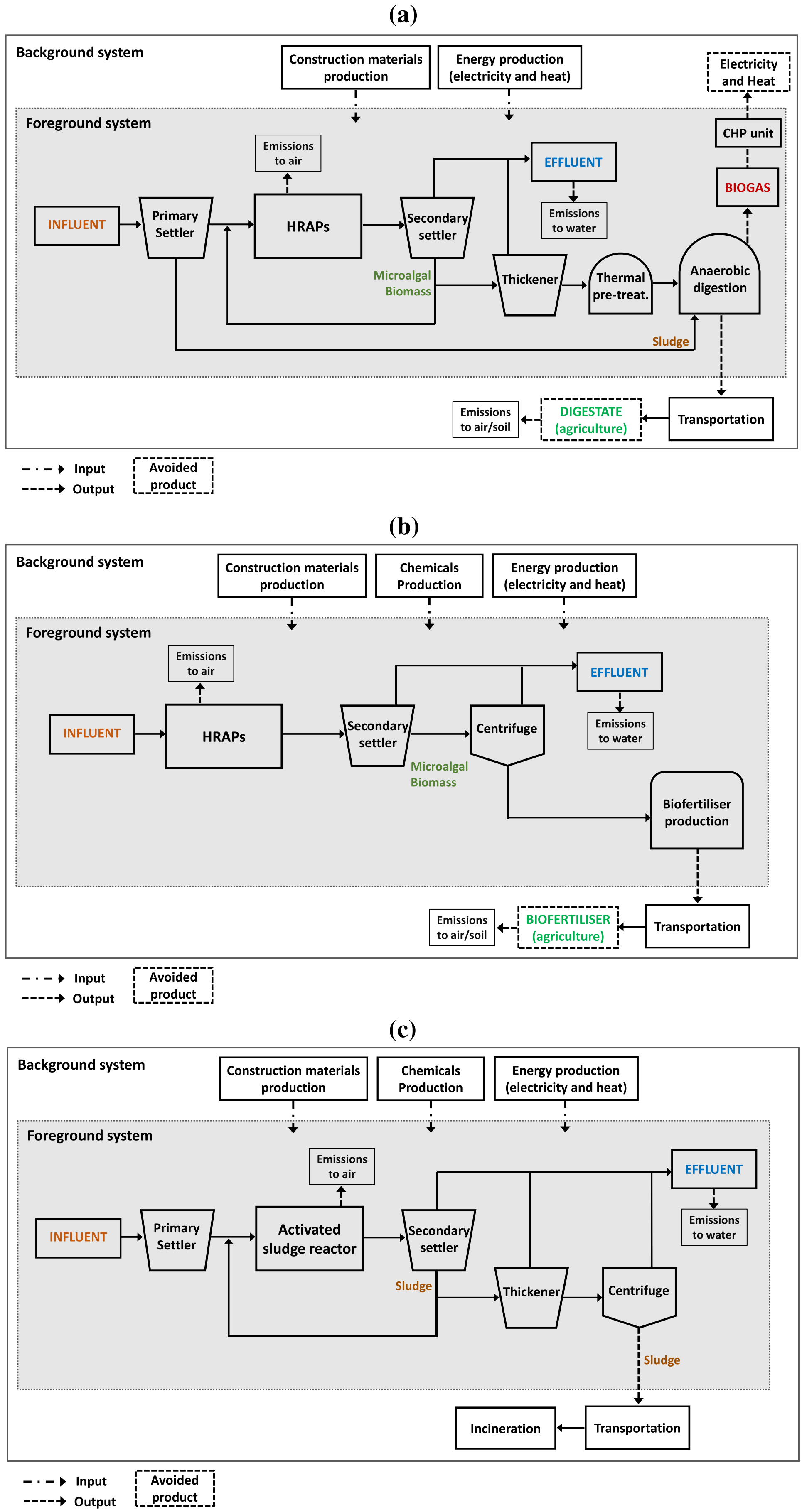
The goal of this study was to determine the potential environmental impact of HRAP systems for wastewater treatment and resource recovery. In particular, two configurations were compared:

Table 3
Characteristics and design parameters of the activated sludge system (Scenario 3).

System characteristics	Unit	
Inlet BOD_5 concentration	$mg_{BOD}\ L^{-1}$	300
Outlet BOD_5 concentration	$mg_{BOD}\ L^{-1}$	<25
Outlet TSS concentration	$mg_{TSS}\ L^{-1}$	<35
Flow rate	$m^3\ d^{-1}$	1950
Population equivalent	p.e.	10,000
Total surface area	m^2	900
Specific area requirement	$m^2\ p.e.^{-1}$	0.6
Design parameters		
Primary settler HRT	h	2.5
Activated sludge reactor HRT	h	6
Secondary settler HRT	h	2

Note: BOD: Biochemical oxygen demand; TSS: Total suspended solids; HRT: Hydraulic Retention Time; OLR: Organic Loading Rate.

Fig. 1. Flow diagrams and system boundaries of the wastewater treatment alternatives: a) HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production) (Scenario 1); b) HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production) (Scenario 2); c) activated sludge system (Scenario 3).


(a)
Background system
Construction materials production
Energy production (electricity and heat)
Electricity and Heat
Foreground system
CHP unit
BIOGAS
Emissions to air
EFFLUENT
Emissions to water
INFLUENT
Primary Settler
HRAPs
Secondary settler
Thickener
Thermal pre-treat.
Anaerobic digestion
Microalgal Biomass
Sludge
Emissions to air/soil
DIGESTATE (agriculture)
Transportation
Input
Output
Avoided product
(b)
Background system
Construction materials production
Chemicals Production
Energy production (electricity and heat)
Foreground system
Emissions to air
EFFLUENT
INFLUENT
HRAPs
Secondary settler
Centrifuge
Emissions to water
Microalgal Biomass
Biofertiliser production
Emissions to air/soil
BIOFERTILISER (agriculture)
Transportation
Input
Output
Avoided product
(c)
Background system
Construction materials production
Chemicals Production
Energy production (electricity and heat)
Foreground system
Emissions to air
EFFLUENT
Emissions to water
INFLUENT
Primary Settler
Activated sludge reactor
Secondary settler
Sludge
Thickener
Centrifuge
Sludge
Incineration
Transportation
Input
Output
Avoided product

a) a HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production) (Scenario 1);
b) a HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production) (Scenario 2).

Moreover, both scenarios were compared to a typical small-sized activated sludge system implemented in Spain (Scenario 3). The functional unit (FU) for this study was set as 1 m^3 of treated water, since the main function of the technologies proposed is to treat wastewater.

The cradle-to-grave boundaries included systems construction, operation and maintenance over a 20-years period (Garfí et al., 2017; Pérez-López et al., 2017; Rahman et al., 2016) (Fig. 1). Input and output flows of materials (i.e. construction materials and chemicals) and energy resources (heat and electricity) were systematically studied for all scenarios. Direct GHG emissions and NH_4^+ volatilization associated with wastewater treatment were also included in the boundaries. As treated water is discharged into the environment, direct emissions to water were also taken into account. Regarding digestate and biofertilizer reuse in agriculture in Scenarios 1 and 2, transportation (20 km) (Hospido et al., 2004) and direct emissions to soil (heavy metals), as well as direct GHG emissions, were accounted for. In the case of the activated sludge system (Scenario 3), inputs and outputs associated with sludge disposal (i.e. incineration) were also included in the boundaries. An average distance of 30 km was considered for sludge transportation to incineration facilities, based on circumstances generally observed in our zone. The end-of-life of infrastructures and equipment were neglected, since the impact would be marginal compared to the overall impact.

Since the studied scenarios would generate by-products (i.e. biogas, biofertilizer), the system expansion method has been used following the ISO guidelines (Guinée, 2002; ISO, 2006). In this method, by-products are supposed to avoid the production of conventional products. Thus, the impact related to conventional products is withdrawn from the overall impact of the system (Collet et al., 2011; ISO, 2006; Sfez et al., 2015). In this study, the digestate and the biofertilizer produced in HRAP systems coupled with biogas and biofertilizer production (Scenarios 1 and 2, respectively) were considered as substitutes to chemical fertilizer. Moreover, the avoided burdens of using heat and electricity produced in Scenario 1 (HRAP systems coupled with biogas production), instead of heat from natural gas and electricity supplied through the grid, were also considered.

2.2.2. Inventory analysis

Inventory data for the investigated scenarios are summarized in Tables 4, 5 and 6. In the case of HRAP systems coupled with biogas and biofertilizer production (Scenarios 1 and 2), inventory data regarding construction materials and operation were based on the detailed engineering designs performed in the frame of this study. Treated wastewater characteristics were estimated considering the removal efficiencies and experimental results obtained in the pilot systems implemented at the Universitat Politècnica de Catalunya-BarcelonaTech (UPC) (5 m^2) (Gutiérrez et al., 2016) and at the Las Palmerillas Experimental Station (100 m^2) (Morales-Amaral et al., 2015a) for Scenarios 1 and 2, respectively. NH_4^+ volatilization was estimated through nitrogen mass balance. NH_3 and N_2O emissions due to the application of digestate and biofertilizer on agricultural land were calculated using emissions factors from the literature (Hospido et al., 2008; IPCC, 2006; Lundin et al., 2000). In this case, CH_4 emissions were not considered since anaerobic decompositions do not occur if liquid fertilizer is used and the climate is predominantly dry (Hobson, 2003; Lundin et al., 2000). Heavy metals and nutrients (avoided Total Nitrogen (TN) and Total Phosphorous (TP)) content of the digestate and biofertilizer were gathered from experimental results obtained in the above-mentioned pilot systems (Morales-Amaral et al., 2015a; Solé-Bundó et al., 2017). In order to estimate electricity and heat production from biogas cogeneration in Scenario 1 (HRAP systems coupled with biogas production), biogas production obtained in lab-scale experiments was taken into account (Solé-Bundó et al., 2015; Passos et al., 2017).

Table 4
Summary of the inventory for Scenario 1: HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production). Values are referred to the functional unit (1 m^3 of water).

	Scenario 1	Units
Inputs		
Construction materials		
Primary settler		
Concrete	2.55E-06	$m^3\ m^{-3}$
Steel	2.04E-04	$kg\ m^{-3}$
HRAPs		
Concrete	5.94E-04	$m^3\ m^{-3}$
Steel	4.76E-02	$kg\ m^{-3}$
Secondary settler		
Concrete	1.29E-05	$m^3\ m^{-3}$
Steel	1.03E-03	$kg\ m^{-3}$
Thickener		
Concrete	1.78E-07	$m^3\ m^{-3}$
Steel	1.42E-05	$kg\ m^{-3}$
Thermal pretreatment		
Concrete	2.77E-07	$m^3\ m^{-3}$
Steel	2.22E-05	$kg\ m^{-3}$
Digester		
Concrete	9.79E-06	$m^3\ m^{-3}$
Steel	7.83E-04	$kg\ m^{-3}$
Operation		
Energy consumption[a]		
Primary settler	4.41E-03	$kWh\ m^{-3}$
HRAPs	1.13E-02	$kWh\ m^{-3}$
Secondary settler	2.52E-03	$kWh\ m^{-3}$
Thermal pretreatment	1.08E-04	$kWh\ m^{-3}$
Digester	4.17E-02	$kWh\ m^{-3}$
Total energy consumption	6.00E-02	$kWh\ m^{-3}$
Outputs		
Emissions to water[a]		
Total COD	7.63E + 01	$g\ m^{-3}$
TSS	2.40E + 01	$g\ m^{-3}$
TN	9.38E + 00	$g\ m^{-3}$
TP	3.69E + 00	$g\ m^{-3}$
Emissions to air[a]		
NH_4^+ volatilization in HRAPs		
NH_3	3.80E + 00	$g\ m^{-3}$
Digestate application as fertilizer		
NH_3	6.47E + 00	$g\ m^{-3}$
N_2O	2.59E-01	$g\ m^{-3}$
Emissions to soil[a]		
Digestate application as fertilizer		
Cd	3.53E-03	$g\ m^{-3}$
Cu	2.02E-01	$g\ m^{-3}$
Pb	9.08E-02	$g\ m^{-3}$
Zn	9.04E-01	$g\ m^{-3}$
Ni	4.15E-02	$g\ m^{-3}$
Cr	5.22E-02	$g\ m^{-3}$
Hg (value<)	4.52E-04	$g\ m^{-3}$
Avoided products[a]		
Electricity (from biogas cogeneration)	5.40E-01	$kWh\ m^{-3}$
Heat (from biogas cogeneration)	8.49E-01	$kWh\ m^{-3}$
N as fertilizer (from digestate reuse)	2.59E + 01	$g\ m^{-3}$
P as fertilizer (from digestate reuse)	1.31E + 00	$g\ m^{-3}$

[a] Annual averages.

As mentioned above, data regarding the typical small-sized activated sludge system implemented in Spain (Scenario 3) were gathered from the literature (Gallego et al., 2008; Garfí et al., 2017; Lorenzo-Toja et al., 2015).

Background data (i.e. data of construction materials, chemicals, energy production, avoided fertilizer, transportation and sludge incineration process) were obtained from the *Ecoinvent 3.1* database (Moreno-Ruiz et al., 2014; Weidema et al., 2013). The Spanish electricity mix was used for all electricity requirements (Red Eléctrica Española, 2016).

Table 5
Summary of the inventory for Scenario 2: HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production). Values are referred to the functional unit (1 m^3 of water).

	Scenario 2	Units
Inputs		
Construction materials		
HRAPs		
Concrete	4.32E-04	$m^3\ m^{-3}$
Steel	3.45E-02	$kg\ m^{-3}$
Secondary settler		
Concrete	1.29E-05	$m^3\ m^{-3}$
Steel	1.03E-03	$kg\ m^{-3}$
Centrifuge		
Steel	3.86E-05	$kg\ m^{-3}$
Operation		
Energy consumption[a]		
HRAPs	1.11E-02	$kWh\ m^{-3}$
Secondary settler	5.77E-03	$kWh\ m^{-3}$
Centrifuge	1.15E-02	$kWh\ m^{-3}$
Biofertilizer production	4.70E-02	$kWh\ m^{-3}$
Total energy consumption	7.54E-02	$kWh\ m^{-3}$
Chemicals[a]		
Organic flocculant	1.00E + 01	$kg\ m^{-3}$
Outputs		
Emissions to water[a]		
Total COD	1.00E + 02	$g\ m^{-3}$
TSS	5.00E + 01	$g\ m^{-3}$
TN	2.00E + 00	$g\ m^{-3}$
TP	1.00E + 00	$g\ m^{-3}$
Emissions to air[a]		
NH_4^+ volatilization in HRAPs		
NH_3	5.00E + 00	$g\ m^{-3}$
Biofertilizer		
NH_3	1.44E + 00	$g\ m^{-3}$
N_2O	5.77E-02	$g\ m^{-3}$
Emissions to soil[a]		
Biofertilizer		
Cd	3.46E-04	$g\ m^{-3}$
Cu	4.62E-02	$g\ m^{-3}$
Pb	2.31E-02	$g\ m^{-3}$
Zn	1.15E-02	$g\ m^{-3}$
Ni	1.15E-02	$g\ m^{-3}$
Cr	3.46E-02	$g\ m^{-3}$
Hg (value<)	2.31E-04	$g\ m^{-3}$
Avoided products[a]		
N as fertilizer (from biofertilizer)	5.77E + 00	$g\ m^{-3}$
P as fertilizer (from biofertilizer)	1.20E + 00	$g\ m^{-3}$

[a] Annual averages.

Table 6
Summary of the inventory for Scenario 3: typical small-sized activated sludge system implemented in Spain. Values are referred to the functional unit (1 m^3 of water).

	Scenario 3	Units
Inputs		
Construction materials		
Concrete	1.65E-05	$m^3\ m^{-3}$
Steel	1.32E-03	$kg\ m^{-3}$
Operation		
Energy consumption		
Electricity	8.90E-01	$kWh\ m^{-3}$
Chemicals		
Polyelectrolyte	1.98E + 00	$g\ m^{-3}$
Coagulant	3.18E + 00	$g\ m^{-3}$
Outputs		
Emissions to water		
Total COD	1.25E + 02	$g\ m^{-3}$
TSS	3.50E + 01	$g\ m^{-3}$
TN	1.50E + 01	$g\ m^{-3}$
TP	2.00E + 00	$g\ m^{-3}$
Emissions to air		
CO_2	1.70E-01	$g\ m^{-3}$
N_2O	1.10E-01	$g\ m^{-3}$
Waste to further treatment		
Sludge (incineration)	1.24E + 00	$kg\ m^{-3}$

2.2.3. Impact assessment

The LCA was performed using the software *SimaPro® 8* (PRé Sustainability, 2014). Potential environmental impacts were calculated by the ReCiPe midpoint method (hierarchist approach) (Goedkoop et al., 2009). In this study, characterization phase was performed considering the following impact categories: Climate Change, Ozone Depletion, Terrestrial Acidification, Freshwater Eutrophication, Marine Eutrophication, Photochemical Oxidant Formation, Particulate Matter Formation, Metal Depletion, Fossil Depletion, Human Toxicity and Terrestrial Ecotoxicity. These impact categories were selected according to the most relevant environmental issues related to wastewater treatment and used in previous LCA studies (Corominas et al., 2013; Fang et al., 2016; Gallego et al., 2008; Garfí et al., 2017; Hospido et al., 2008). Normalization was carried out in order to compare all the environmental impacts at the same scale. This provides information on the relative significance of the indicator results, allowing a fair comparison between the impacts estimated for each scenario (ISO, 2006). In this study, the European normalization factors have been used (Europe ReCiPe H) (Goedkoop et al., 2009).

2.3. Sensitivity analysis

In order to evaluate the influence that the most relevant assumptions have on the results, a sensitivity analysis was performed considering the following parameters: NH_3 emissions due to the application of digestate and biofertilizer on agricultural land (Scenario 1 and 2); N_2O emissions due to the application of digestate and biofertilizer on agricultural land (Scenario 1 and 2); digestate and biofertilizer transportation distance (Scenario 1 and 2). A variation of $\pm 10\%$ was considered for all parameters and the sensitivity coefficient was calculated using Eq. (1) (Dixon et al., 2003):

$$\text{Sensitivity Coefficient (S)} = \frac{\left(\text{Output}_{\text{high}} - \text{Output}_{\text{low}}\right)/\text{Output}_{\text{default}}}{\left(\text{Input}_{\text{high}} - \text{Input}_{\text{low}}\right)/\text{Input}_{\text{default}}} \quad (1)$$

where Input is the value of the input variable (e.g. NH_3 and N_2O emissions) and Output is the value of the environmental indicator (e.g. Climate Change).

2.4. Seasonality

Annual averages of potential environmental impacts from HRAPs scenarios (Scenario 1 and 2) were compared to those obtained considering the microalgal biomass production achieved in summer and winter months (highest and lowest production, respectively; Tables 1 and 2) to assess their fluctuations over the year. In particular, the microalgal biomass production considered for Scenario 1 (HRAP systems coupled with biogas production) was 5 and 25 $g_{TSS}\ m^{-2}\ d^{-1}$ for winter and summer months, respectively. On the other hand, for Scenario 2 (HRAP systems coupled with biofertilizer production) a microalgal biomass production of 15 and 30 $g_{TSS}\ m^{-2}\ d^{-1}$ was considered for winter and summer months, respectively.

2.5. Economic assessment

The economic assessment was performed comparing the capital cost and the operation and maintenance cost of Scenarios 1 and 2 (HRAP systems coupled with biogas and biofertilizer production, respectively). The capital cost included the cost for earthmoving and construction materials purchase. On the other hand, operation and maintenance cost comprised costs associated with energy (electricity and heat) consumption and chemicals purchase. In both scenarios, prices were provided by local companies. For Scenario 1 (HRAP systems coupled with biogas production), the surplus electricity generated from biogas cogeneration was supposed to be sold back to the grid. Thus, the price of electricity sold to the grid was withdrawn from the overall operational and maintenance cost of the system. For Scenario 2 (HRAP systems coupled with biofertilizer production), the dewatered microalgae biomass is sold to a local company (BIORIZON BIOTECH S.L.) to produce the biofertilizer (Romero-García et al., 2012). Therefore, its price was withdrawn from the overall operational and maintenance cost of the system. Other costs (e.g. labour costs, transportation) were assumed to be similar in both scenarios and, thus, were not included in the analysis.

3. Results and discussion

3.1. Life cycle assessment

3.1.1. Characterization

The potential environmental impacts associated with each alternative are shown in Fig. 2. Comparing HRAP scenarios (Scenarios 1 and 2), the results show that Scenario 2 is the most environmentally friendly alternative in 7 out of 11 impact categories. As far as Climate Change,

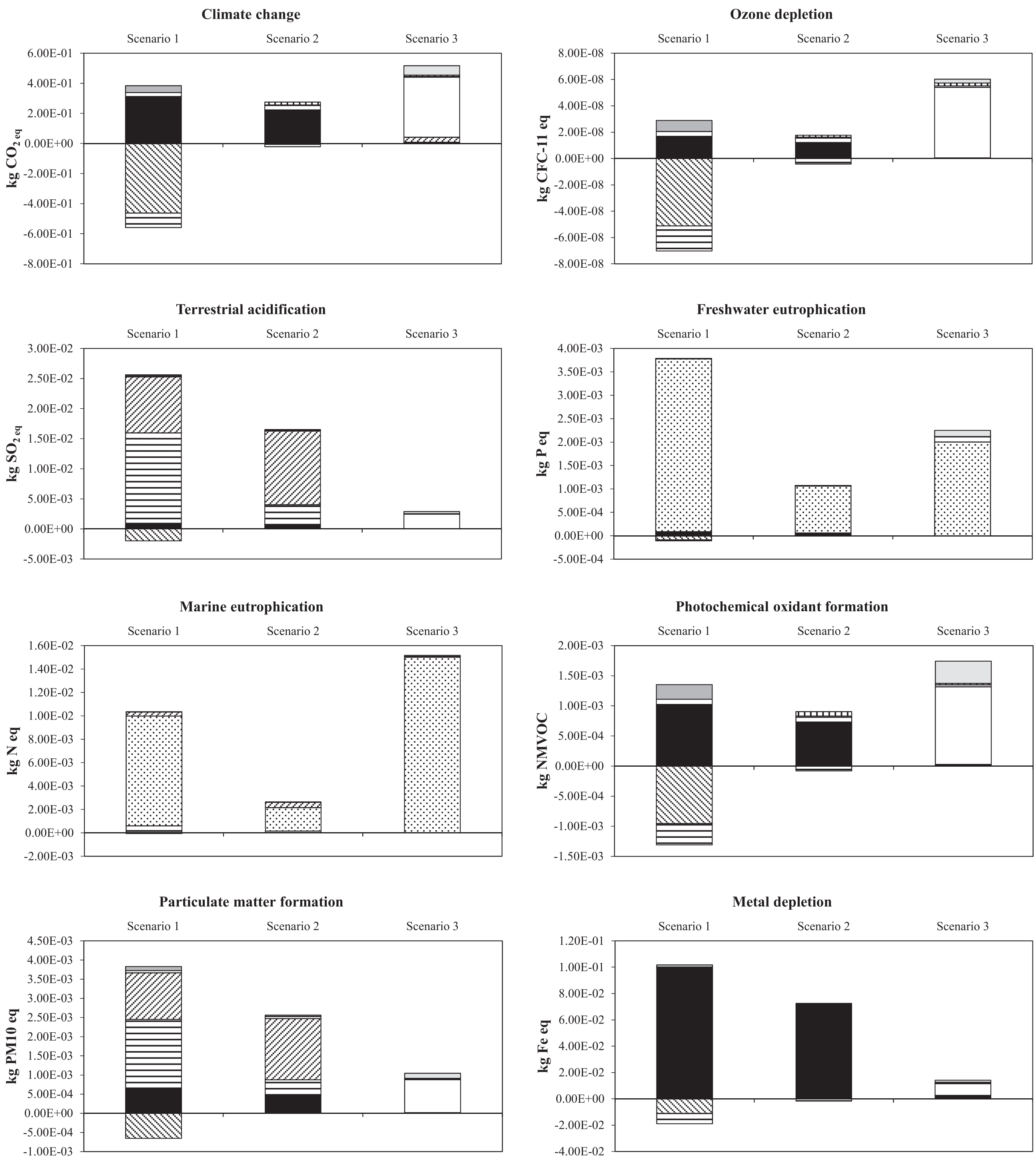


Fig. 2. Potential environmental impacts for the three scenarios: a) HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production) (Scenario 1); b) HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production) (Scenario 2); c) activated sludge system (Scenario 3). Values are referred to the functional unit (1 m^3 of water).

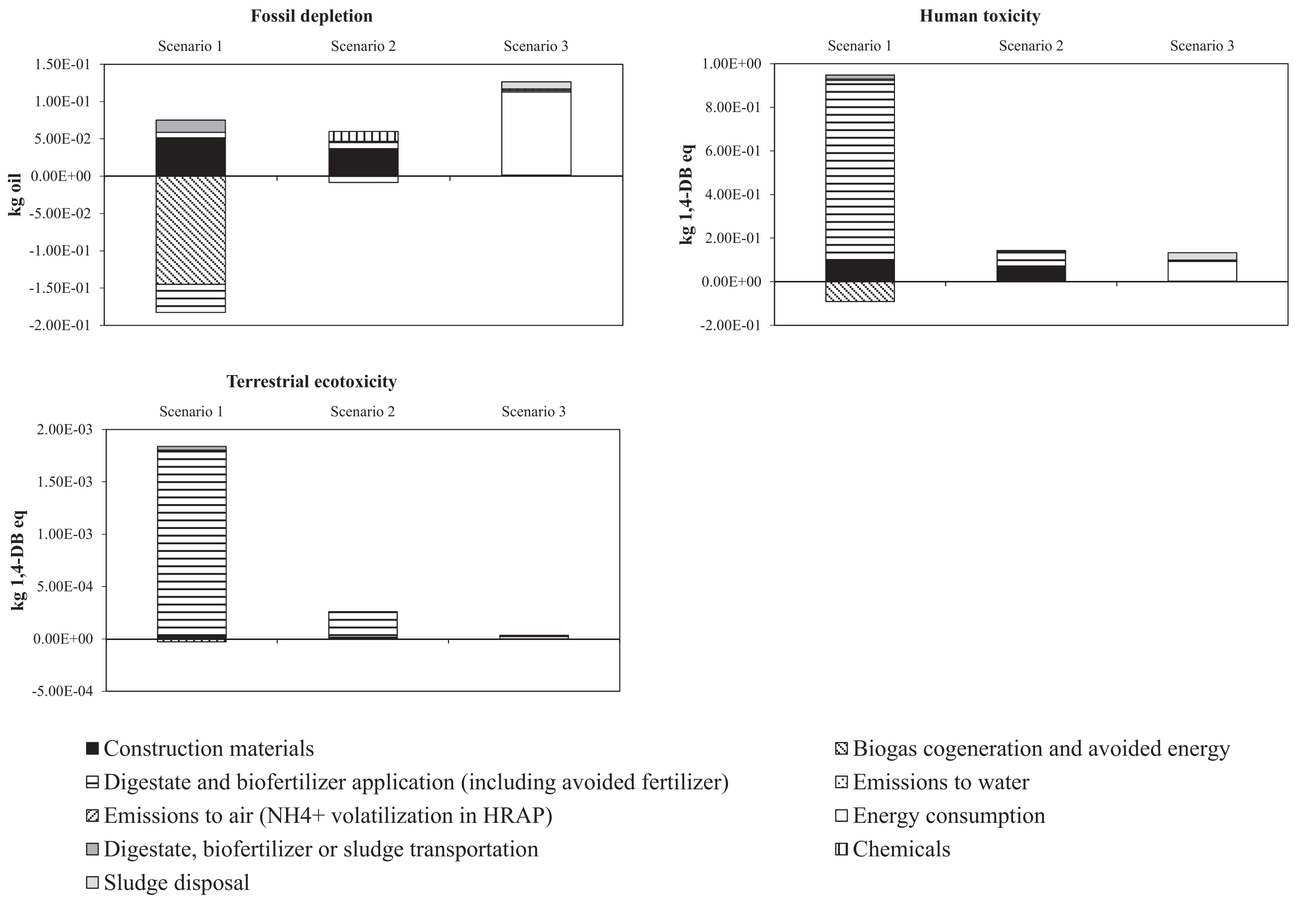


Fig. 2 (*continued*).

Ozone Depletion, Photochemical Oxidant Formation and Fossil Depletion Potentials are concerned, the potential environmental impact of Scenario 1 was lower than Scenario 2. This was mainly due to the offset energy generated from biogas cogeneration and the avoided fertilizer (Fig. 2). In particular, the electricity generated by biogas cogeneration (avoided electricity) was around 9 times higher than that consumed for system operation in Scenario 1 (Table 4). It means that the surplus electricity could be sold to the grid. This is in accordance with previous studies that observed that, in a HRAP system for wastewater treatment, the energy balance is always positive when microalgal biomass is co-digested with primary sludge and the biogas is used to cogenerate electricity and heat (Passos et al., 2017). Moreover, it has to be noticed that the contribution of the avoided fertilizer to the overall impact was higher in Scenario 1 than Scenario 2 (Fig. 2), since TN avoided was higher in the former compared to the latter (25.9 vs. 5.77 g m^{-3} of water; Tables 4 and 5). This can be explained by the fact that, despite TN content was higher in the biofertilizer (5 g_{TN} $kg^{-1}_{biofertilizer}$) than in the digestate (1.89 g_{TN} $kg^{-1}_{digestate}$), a lower amount of biofertilizer is produced in Scenario 2 (1.15 $kg_{biofertilizer}$ m^{-3} of water) compared to Scenario 1 (13.7 $kg_{digestate}$ m^{-3} of water). Indeed, the total solids (TS) content of the microalgal biomass obtained in Scenario 1 (2% TS) is lower compared to Scenario 2 (20%TS) due to its dewatering step (i.e. centrifugation). Nevertheless, it has to be mentioned that the biofertilizer is a higher quality product compared to the digestate, since it contains high amounts of proteins rich in essential amino acids, as well as phytohormones that stimulate plant growth and improve soil quality (Coppens et al., 2016; García-Gonzalez and Sommerfeld, 2016; Jäger et al., 2010; Uysal et al., 2015). However, these benefits were not taken into account in this study. Regarding Terrestrial Acidification and Particulate Matter Formation Potentials, Scenario 2 showed lower risks to endanger the environment because this configuration causes fewer emissions to air (i.e. NH_3 emissions) derived from biofertilizer application to agricultural soil compared to digestate from Scenario 1 (Tables 4 and 5). With regards to Freshwater and Marine Eutrophication Potentials, Scenario 1 showed higher environmental impacts compared to Scenario 2. It is explained by the quality of treated effluent (i.e. lower TN and TP removal efficiencies in Scenario 1 than in Scenario 2; Tables 4 and 5). The reason for this difference could be primarily due to the distinct climatic conditions, since the average temperature and global solar radiation in Catalonia (Scenario 1), as previously mentioned, are lower than in Andalucía (Scenario 2). Indeed, previous studies reported that nutrient removal efficiencies are improved with higher temperature and solar radiation (Craggs et al., 2012; Mehrabadi et al., 2016). Concerning Metal Depletion Potential, Scenario 1 would impair abiotic resources more likely than Scenario 2. Since Metal Depletion Potential is mainly influenced by construction materials, the lower environmental performance of Scenario 1 is owing to the larger surface area required for its implementation compared to Scenario 2 (4 m^2 p.e.$^{-1}$ vs. 3 m^2 p.e.$^{-1}$, respectively). As mentioned above, in the system implemented in Catalonia (Scenario 1), a higher HRT is needed (especially during winter months) compared to that implemented in Andalucía (Scenario 2) in order to obtain a effluent quality suitable for discharge (García et al., 2000; Gutiérrez et al., 2016; Morales-Amaral et al., 2015a; Morales-Amaral et al., 2015b). The influence of the geographical location on the performance of HRAPs was also addressed in previous studies, in which the use of this technology is not encouraged in northern regions, where the climatic conditions are not favourable to promote efficient wastewater treatment and biomass productivity (Grönlund and Fröling, 2014; Pérez-López et al., 2017). According to this, it is noteworthy to mention that, since in this study the two HRAP systems (Scenarios 1 and 2) were assumed to be implemented in locations with distinct climatic conditions, it is not possible to define the best biomass valorization strategy (i.e. biogas vs. biofertilizer production). In fact, HRAP systems operating under similar conditions should be considered in order to enable a better comparison. In regard to Human toxicity and Terrestrial Ecotoxicity Potentials, Scenario 1 showed higher environmental impacts compared to Scenario 2 due to the higher concentration of heavy metals in the digestate than in the biofertilizer (Tables 4 and 5).

According to the results presented in Fig. 2, Scenarios 1 and 2 showed lower environmental impacts in 6 out of 11 impact categories (i.e. Climate Change, Ozone Depletion, Freshwater and Marine Eutrophication, Photochemical Oxidant Formation, Fossil Depletion) compared to Scenario 3. This was primarily due to the lower energy consumption needed for system operation in HRAP scenarios (Scenario 1 and 2) than in the activated sludge system (Scenario 3) (Tables 4, 5 and 6). On the other hand, HRAP scenarios (Scenario 1 and 2) showed lower environmental performance in Metal Depletion category (Fig. 2), since a higher amount of construction materials are needed for their implementation compared to the activated sludge system (Scenario 3). Indeed, even if HRAP systems have low raw materials requirements for their operation, a large amount of raw materials is needed for their construction. This fact could make HRAP systems less favourable than conventional technologies (e.g. activated sludge systems) in the abiotic resources depletion impact categories. Nevertheless, this drawback can be overcome by implementing HRAP systems in smaller agglomerations than that considered in this study (e.g. around 2000 p.e.) (Garfí et al., 2017). As far as Terrestrial Acidification, Particulate Matter Formation, Human Toxicity and Terrestrial Ecotoxicity Potentials are concerned, the potential environmental impacts of HRAPs scenarios (Scenario 1 and 2) were higher than that caused by the activated sludge system (Scenario 3). It was mainly due to the NH_3 air emissions derived from NH_4^+ volatilization in HRAPs and to the heavy metals content in the digestate/biofertilizer (emissions to soil). The results are consistent with previous studies that reported increased toxicity in a comparative LCA by integrating a sidestream process into a conventional wastewater treatment facility where microalgae are cultivated, harvested and then used for fertigation (Fang et al., 2016). Furthermore, it was observed that the higher impacts on terrestrial environments are unavoidable in cases where sludge and nutrients from wastewater are recycled and reused in agriculture (Tangsubkul et al., 2005). In order to address this issue, improved technologies to separate better heavy metals from recycled sludge should be encouraged (Tangsubkul et al., 2005). In regard to Freshwater Eutrophication Potential, the activated sludge system (Scenario 3) showed higher potential environmental impact compared to Scenario 2, but lower impact than Scenario 1. This was because of the higher outlet Phosphorous concentration in Scenario 1 compared to the other scenarios, which might be related to the lower nutrients removal efficiency caused by less favourable climatic conditions. Previous studies observed that eutrophication and toxicity impact categories were mainly affected by water discharge emissions and sludge management, indicating that the best alternatives seem to be the ones that provide lower nutrients and heavy metals emissions (Corominas et al., 2013). This corroborates with the results obtained with this study, where the configuration with higher nutrients concentration in the effluent and higher levels of heavy metals in the recycled biomass (Scenario 1) showed higher impacts in those categories.

On the whole, HRAP systems coupled with biogas and biofertilizer production (Scenario 1 and 2) showed similar environmental performance if compared to the activated sludge system (Scenario 3). In particular, HRAPs environmental performance is better than the conventional system in the climate change, ozone layer depletion, photochemical oxidant formation, and fossil depletion impact categories. It was in accordance with previous studies, which stated that, compared to a typical medium-sized conventional wastewater treatment plant, a HRAP system coupled with biogas production could offer clear benefits with regard to the protection of climate, protection of fossil resources and ozone depletion (Maga, 2016). In order to reduce the environmental impacts of HRAP systems for wastewater treatment and resource recovery, the following improvements should be addressed and further assessed: i) reducing NH_4^+ volatilization in HRAPs by controlling the pH through CO_2 injection; ii) ensuring higher nutrients removal efficiencies by selecting a favourable geographical location to implement the HRAP systems; iii) studying improved technologies to separate heavy metals from recycled microalgal biomass; iv) improving HRAP design in order to decrease the amount of construction materials used (e.g. excavation instead of concrete structure).

3.1.2. Normalization

The normalised results show that Freshwater Eutrophication, Marine Eutrophication, Terrestrial Acidification and Human Toxicity Potentials are the most significant impact categories for all the scenarios considered (Fig. 3). These results are in accordance with previous LCAs on wastewater treatment (Fang et al., 2016; Gallego et al., 2008; Hospido et al., 2004). In these impact categories, Scenario 2 showed to be the most environmentally friendly alternative.

3.2. Sensitivity analysis

The results of the sensitivity analysis are shown in Table 7, where the most sensitive inventory components are indicated by bold type.

The results showed that Terrestrial Acidification and Particulate Matter Formation Potentials are somewhat sensitive to NH_3 emissions due to the application of digestate on agricultural land in Scenario 1 (sensitivity coefficient around 0.3 for both environmental indicators). Indeed, a 10% increase of this parameter would increase these indicators by around 3%.

Similarly, Climate Change Potential showed to be somewhat sensitive to N_2O emissions due to the application of digestate on agricultural land in Scenario 1 (sensitivity coefficient = 0.36). This means that a 10% increase in N_2O direct emissions would increase this environmental indicator by 3.6%.

Moreover, Photochemical Oxidant Formation Potential showed to be sensitive to digestate transportation distance in Scenario 1 (sensitivity coefficient = 2.7). Indeed, a 10% increase in digestate transportation distance would increase this environmental indicator by 27%. The transport of the sludge to agricultural applications is not a fixed parameter, as it depends on specific needs. However, the sludge is usually applied in soil relatively close to the plant location (Pasqualino et al., 2009).

In conclusion, the results were found to be sensitive to digestate transportation distance in Scenario 1. Nevertheless, since it mainly affect only one of the less significant impact categories considered (i.e. Photochemical Oxidant Formation Potential), it can be concluded that the main findings of this study are not strongly dependent on the assumptions considered.

3.3. Seasonality

The seasonal variation of the potential environmental impact for HRAPs scenarios (Scenario 1 and 2) are shown in Fig. 4. The potential environmental impacts of Scenario 2 are fairly constant over the year. On the contrary, a strong seasonal variation was observed in Scenario 1. It was due to the fact that the microalgal biomass production range in Scenario 1 (5–25 g_{TSS} m^{-2} d^{-1}) is lower than Scenario 2 (15–-30 g_{TSS} m^{-2} d^{-1}) and represents a high variation due to the seasonal fluctuations. It was in accordance with previous studies, which reported that meteorological conditions played a critical role in the LCA results of HRAPs for microalgal cultivation (Pérez-López et al., 2017). The authors highlighted that HRAPs are more suitable for locations where warm temperatures and high solar radiation are predominant (Pérez-López et al., 2017). Moreover, electricity and flocculants consumption, as well as water and biofertilizer characteristics, are fairly constant over the year in Scenario 2, while the biogas production and, consequently, the energy avoided, strongly depend on microalgal biomass production.

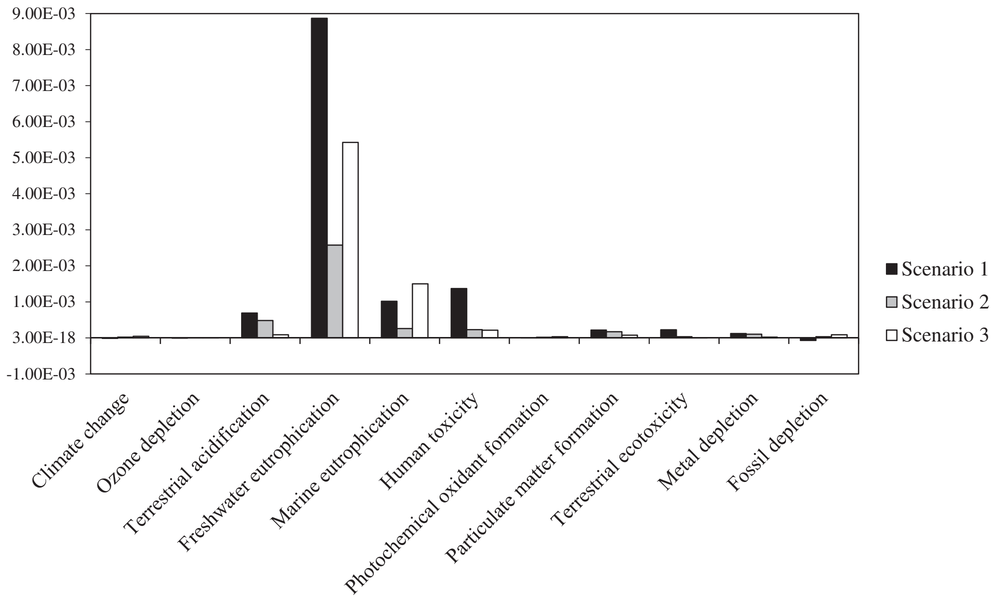


Fig. 3. Normalised potential environmental impacts for the three scenarios: a) HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production) (Scenario 1); b) HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertiliser production) (Scenario 2); c) activated sludge system (Scenario 3).

These facts have a great influence on the environmental impacts seasonality in Scenario 1. As a result, Scenario 2 remained the most environmentally friendly alternative in 7 out of 11 impact categories compared to Scenario 1 over the year. Similarly, HRAPs scenarios (Scenario 1 and 2) still showed lower potential environmental impacts in 6 out of 11 impact categories compared to activated sludge system (Scenario 3) considering seasonal fluctuations.

3.4. Economic assessment

Results of the economic analysis are shown in Table 8. With respect to capital costs, Scenario 2 appeared as the less expensive alternative. It was due to its lower specific area requirement and, thus, lower amount of purchased materials, compared to Scenario 1 (3 vs. 4 m^2 p.e.$^{-1}$, respectively). Similar capital costs were found in previous studies which carried out an economic analysis of HRAPs for wastewater treatment without any resource recovery strategies (Garfí et al., 2017; Molinos-Senante et al., 2014). In fact, in this study the capital cost for ponds implementation was around 90% of the total capital cost of the overall systems (i.e. primary settler, ponds, secondary settler, digesters). Since the highest cost is due to ponds construction, implementing downstream units for resource recovery strategies (e.g. digester) in a HRAP system for wastewater treatment would slightly increase its capital costs. Regarding the operation costs, Scenario 2 showed to be the most expensive alternative, since this configuration requires higher expenses for energy and flocculant purchase. Nevertheless, if the price of the co-products (i.e. electricity sold back to the grid, microalgae biomass to produce the biofertilizer) that the wastewater treatment plant could sell out are considered, Scenario 2 would be the most cost-effective alternative (Table 8). The results of the economic assessment are consistent with previous studies, which indicated that recycling valuable compounds from microalgal biomass (such as nutrients and pigments) is likely to be more economically feasible than producing biogas from it, due to the higher added value of the final products (Ruiz et al., 2016; Vulsteke et al., 2017).

4. Conclusions

In this study, the LCA methodology was a useful tool to identify the main environmental bottlenecks to scale-up high rate algal pond

Table 7
Results of the sensitivity analysis for the considered parameters: NH_3 emissions due to the application of digestate and biofertilizer on agricultural land; N_2O emissions due to the application of digestate and biofertilizer on agricultural land; digestate and biofertilizer transportation distance.

Impact categories	Parameters					
	Scenario 1			Scenario 2		
	NH_3 emissions	N_2O emissions	Digestate transportation	NH_3 emissions	N_2O emissions	Biofertilizer transportation
Climate change	±0.000	***±0.367***	±0.260	±0.000	±0.068	±0.015
Ozone depletion	±0.000	±0.000	±0.204	±0.000	±0.000	±0.053
Terrestrial acidification	***±0.337***	±0.000	±0.008	±0.213	±0.000	±0.001
Freshwater eutrophication	±0.000	±0.000	±0.001	±0.000	±0.000	±0.000
Marine eutrophication	±0.058	±0.000	±0.001	±0.052	±0.000	±0.000
Photochemical oxidant formation	±0.000	±0.000	***±2.713***	±0.000	±0.000	±0.025
Particulate matter formation	***±0.327***	±0.000	±0.033	±0.179	±0.000	±0.003
Metal depletion	±0.000	±0.000	±0.019	±0.000	±0.000	±0.002
Fossil depletion	±0.000	±0.000	±0.153	±0.000	±0.000	±0.027
Human toxicity	±0.000	±0.000	±0.021	±0.000	±0.000	±0.011
Terrestrial ecotoxicity	±0.000	±0.000	±0.019	±0.000	±0.000	±0.011

Note: Scenario 1: HRAP system for wastewater treatment where microalgal biomass is valorized for energy recovery (biogas production); Scenario 2: HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production). The most sensitive inventory components are indicated by bold type.

(HRAP) systems for wastewater treatment and resource recovery in small communities.

Results showed that HRAP system coupled with biogas production showed to be more environmentally friendly than HRAP system coupled with biofertilizer production in the climate change, ozone layer depletion, photochemical oxidant formation, and fossil depletion impact categories. Different climatic conditions have strongly influenced the results obtained in the eutrophication and metal depletion impact categories. In fact, the HRAP system located where warm temperatures and high solar radiation are predominant (HRAP system coupled with biofertilizer production) showed lower impact in those categories due to its higher nutrients removal efficiencies and lower hydraulic retention time (i.e. lower specific area requirement). The characteristics (e.g. total solids, nutrients and heavy metals concentration) of

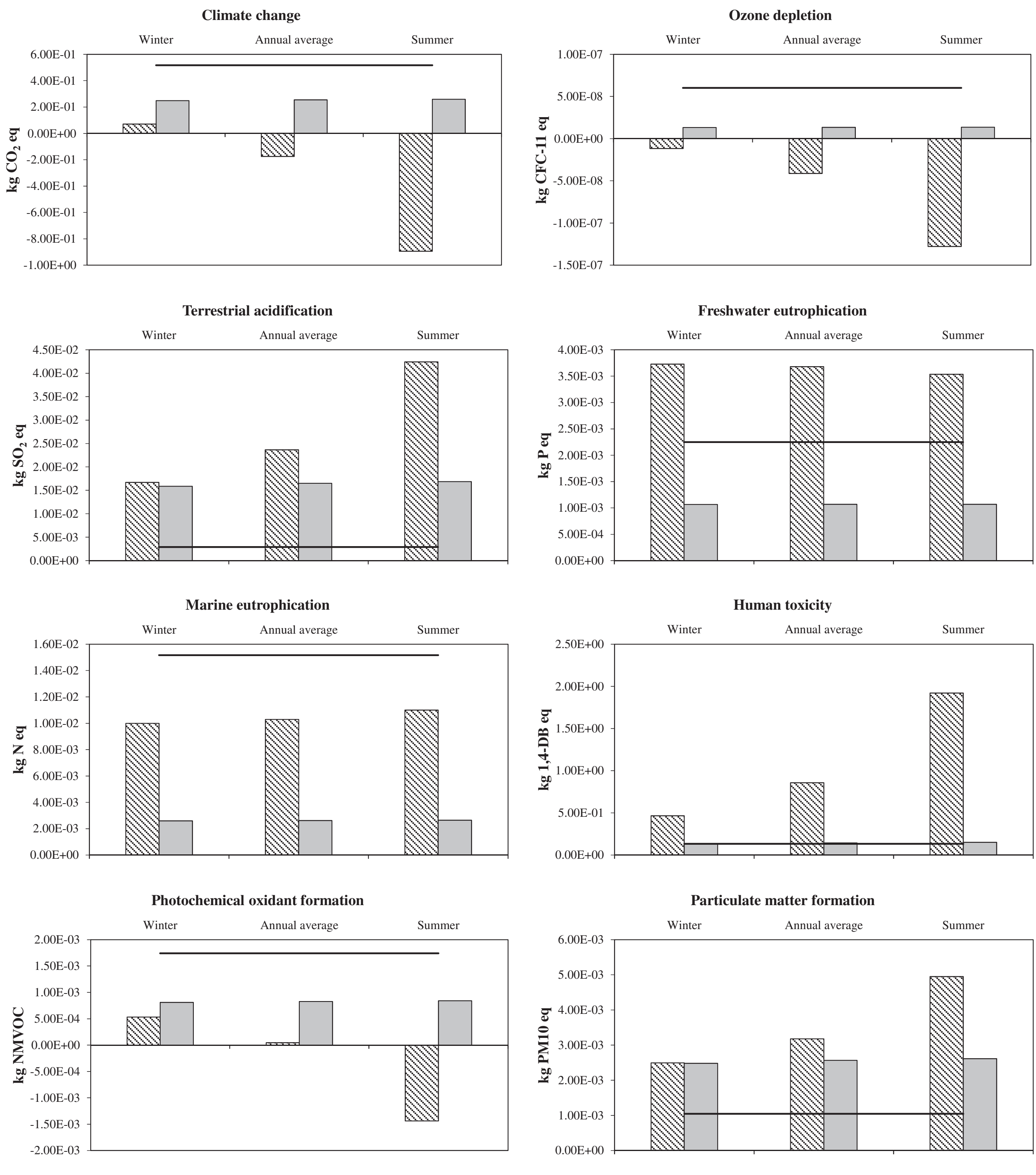


Fig. 4. Seasonal variation of the potential environmental impacts for the three scenarios: a) HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production) (Scenario 1); b) HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production) (Scenario 2); c) activated sludge system (Scenario 3). Values are referred to the functional unit (1 m^3 of water). Potential environmental impacts were calculated considering the microalgal biomass production achieved in summer and winter months (highest and lowest production, respectively).

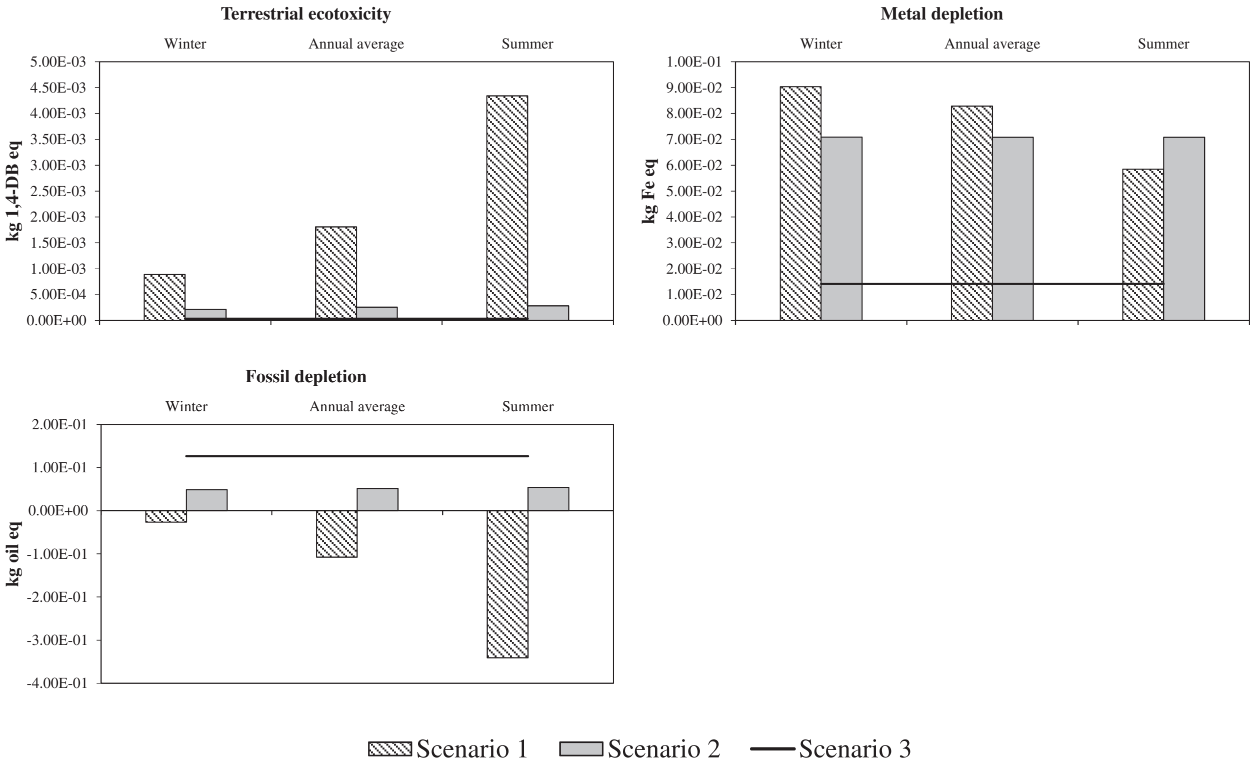


Fig. 4 (*continued*).

microalgal biomass recovered from wastewater appeared to be crucial when assessing the potential environmental impacts in the terrestrial acidification, particulate matter formation and toxicity impact categories.

Normalization identified freshwater eutrophication, marine eutrophication, terrestrial acidification and human toxicity as the most significant impact categories for all the scenarios considered. In these impact categories, HRAP system coupled with biofertilizer production and implemented in warm climate region showed to be the most environmentally friendly alternative.

Additionally, HRAP systems coupled with biogas and biofertilizer production showed lower potential environmental impacts compared to an activated sludge system in the climate change, ozone layer depletion, photochemical oxidant formation, and fossil depletion impact categories.

The environmental performance of HRAP technology for wastewater treatment and resource recovery in small communities might be improved by: i) reducing NH_4^+ volatilization in HRAPs by controlling the pH through CO_2 injection; ii) ensuring higher nutrients removal efficiencies by selecting a favourable geographical location to implement the HRAP systems; iii) studying improved technologies to separate heavy metals from recycled microalgal biomass; iv) improving HRAP design in order to decrease the amount of construction materials used.

In terms of costs, HRAP system coupled with biofertilizer production was the most cost-effective alternative, due to the higher added value of the biofertilizer compared to the energy obtained from biogas cogeneration.

In conclusion, HRAPs are sustainable and cost-effective technology for wastewater treatment in small communities, especially if implemented in warm climate regions and coupled with biofertilizer production. Their implementation and dissemination can help to support a shift towards resource recovery and a sustainable circular economy.

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Table 8
Results of the economic analysis for the HRAPs scenarios.

	Unit	Scenario 1	Scenario 2
Capital cost	€ p.e.$^{-1}$	192.55	139.34
Operation and maintenance cost (energy and flocculant consumption)	€ $m^{-3}{}_{water}$	0.007	0.02
Price of electricity sold back to the grid	€ $m^{-3}{}_{water}$	0.014	–
Price of microalgal biomass sold to a company to produce the biofertilizer	€ $m^{-3}{}_{water}$	–	8.08
Profit (calculated considering operation cost only)	€ $m^{-3}{}_{water}$	0.007	8.06

Note: Scenario 1: HRAP system for wastewater treatment where microalgal biomass is valorised for energy recovery (biogas production); Scenario 2: HRAP system for wastewater treatment where microalgal biomass is reused for nutrients recovery (biofertilizer production).

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